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ABSTRACT

The purpose of this project was to determine workforce needs in the new information technology/knowledge-based world in order to design a coherent minor program in information technology at the University of Arkansas at Little Rock for the non-technically oriented college student. The process consisted of three phases: site visits to five companies in central Arkansas; focus groups of employees in various information technology job types; and a World Wide Web survey of employees of information technology companies in central Arkansas. The survey consisted of four main sections focusing on demographics, non-technical soft-skills (writing and teamwork), business concepts, and technical knowledge/skills/abilities. The fourth area on technical knowledge was further subdivided into eight job clusters: computer programmers; systems/business analysts; computer engineers; database administrators; computer support specialists; network specialists; telecommunications analysts; and Internet specialists. Part 1 of this report provides an overview of the study and demographic results. The companies that participated in the initial site visits and focus groups are described in part 2. Parts 3, 4, and 5 present a detailed analysis of the data collected from the Web survey. Appendices include a copy of the questionnaire, pie chart figures of key survey results, details of soft skills results, and details of business concept results. (AEF)

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Preparing for a New Century: Information Technology Workforce Needs

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By:

Thomas A. Teeter

April 1999

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Information Technology Committee

University of Arkansas at Little Rock 1999

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U·A·L·R

OFFICE OF THE CHANCELLOR

April, 1999

To the Information Technology and Knowledge-Based Companies of Arkansas:

We at the University of Arkansas at Little Rock understand that as a metropolitan university we have a special responsibility to address the challenges facing our state. We understand the significance of the rapid change affecting our society. Much of this change is driven by the increasing use of technology to develop information and control knowledge. Recognizing the economic importance of the use and control of knowledge today and tomorrow, we must rethink our approach to educating students. We must assure that they are well equipped not simply to join the workforce of today, but also to assist in defining the workplace of tomorrow.

This report is the product of nine faculty who have dedicated essentially all of their time outside the classroom to this project. Their challenge was to determine workforce needs in this new Information Technology/Knowledge-Based (IT/KB) world and design a coherent minor program for the non-technically oriented student—that is, an information technology minor for the liberal arts student. The team understood the importance of the challenge early and have worked unselfishly. We owe them our gratitude.

We present in this report the results of our initial efforts to come to a better understanding of the core knowledge base and skill set expected of an entry-level employee in today's knowledge-driven workplace. We could not have generated this information without the total cooperation and enthusiastic participation of the IT/KB companies in Arkansas. While many companies participated, we particularly appreciate the efforts of Acxiom, Alltel, Arksys, BEI Sensors and Systems, the ESI Group, and Inacom.

The Information Technology (IT) Committee first visited with central Arkansas IT/KB companies, listened to their needs, and determined with them the entry-level core knowledge base and skill set. Based on this information, the IT Committee developed an extensive Web-Based survey that allowed hundreds of IT workers throughout the state to share their knowledge of workplace needs and validate the initial concepts the Committee discovered.

We will use what we have learned to inform the design of the curricula in the new College of Information Science and Systems Engineering. In particular, this information will drive the design of the new minor in Information Technology at UALR. We appreciate the interest of other institutions of higher education, both public and private, and will work with them to develop cooperative and independent programs to address the continuing needs of the students of Arkansas on many campuses.

This report is not the end of our efforts in information technology; rather, it is the announcement of a beginning.

Respectfully submitted,

Charles E. Hathaway

Charles E. Hathaway
Chancellor

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Preface

The origins of the work of UALR's Information Technology Committee can be traced back to October 1995. However, at that time, no one could have foreseen the twists and turns that have led to the development of the College of Information Science and Systems Engineering and to the minor in information technology.

At the end of the UALR 2000 planning process, in his formal statement entitled "Creating the Future Together: A Quest for Excellence," Chancellor Charles E. Hathaway announced a number of plans and initiatives. One of these was that UALR Provost Joel E. Anderson should initiate a study to determine whether an engineering program was needed at UALR.

In March 1997, an Engineering Program Study Committee was appointed, chaired by H. James Engstrom. Other members included Eugene P. Levy, Greg Brown, Ed D. Ligon, Jr., Dan Flowers, Dr. Barry D. Lindley, Dr. Mary L. Good, Bob Nabholz, Hon. Bill Gwatney, Gus Vratsinas, Ted Hannah, and Drake Keith.

In October 1997, the Engineering Program Study Committee submitted a report. In the course of its work, the committee, in addition to reviewing large amounts of data on economic, demographic, and educational issues, asked for and received presentations from a number of leaders in business, industry, government, and education. A national consultant that assists businesses in finding sites in which to locate new plants and facilities was brought to campus to meet with the committee, as were the president of Michigan Technological University and the founding dean of the College of Information Technology and Engineering at George Mason University. Representatives of the Knowledge-Based Companies of Arkansas organization also met with the committee.

At the end of its work, the committee recommended that UALR initiate an engineering program with accredited majors in electrical engineering and mechanical engineering, with a heavy systems engineering overlay and integrated use of computer technology.

Chancellor Hathaway shared the report with appropriate University of Arkansas officials and began to discuss it with a number of business and industry leaders. The result was that the proposal from the Engineering Program Study Committee evolved into one that emphasized systems engineering, oriented particularly to the work force needs of the group of internationally competitive knowledge-based companies in Central Arkansas. This became the foundation of the new College of Information Science and Systems Engineering.

Several emerging factors influenced the decision toward a narrower focus on information technology and systems engineering.

1. The Knowledge-Based Companies of Arkansas, an organization of computer-related companies, predicted that Arkansas would experience an estimated 1,300-employee shortfall in 1999, primarily in the areas of information technology. Fewer than 500 Arkansans will be qualified to fill the job openings, which high-tech companies anticipate having this year.
2. The Information Technology Association of America reported a current vacancy in excess of 600,000 and projected that over 3 million jobs in information technology would become available in the next five years.
3. Entry level salaries in Arkansas currently range from the mid-$30,000 for database administrators and programmers to $80,000 for software design engineers. Salaries for these positions appeared to increase by 10% during the second half of 1998.
4. Currently, there is no single existing, integrated program that seeks to educate potential employees for the full range of diverse information technology jobs in Arkansas.

During the time that the proposal was being revised and reshaped, Chancellor Hathaway added one of the most innovative elements of the plan that finally emerged: the minor in information technology.

The minor would serve two important purposes. First, it would make it possible for many graduates, in the Chancellor's words, to put bread on the table while having majored in traditional disciplines that produce more majors than there are jobs available in their respective fields. Such arts and sciences majors (as well as other non-technical disciplines) could present prospective employers not only the communication and problem-solving skills of arts and science majors, but also would have a sufficient grounding in computer-based technology to assume important entry-level positions and to establish careers in hospitals, banks, schools, and other fields that are becoming more and more dependent on information technology.

Second, a minor in information technology would enable the university to graduate in a fairly short period of time a sizable number of students who would be ready for positions in the knowledge-based companies. When Chancellor Hathaway and Provost Anderson made visits to the various companies and businesses to introduce them to the emerging plan the idea of the information technology minor was received with almost universal enthusiasm.

After the Chancellor decided to commit firmly to initiating the minor, he asked Provost Anderson to initiate a process for the development of the minor as a stand-alone curriculum.

Over a period of three months, Provost Anderson invited 67 faculty and professional staff members to lunch, six to ten at a time, to discuss the concept of the minor. The Provost chose faculty members, on the basis of his knowledge of their expertise and experience and openness to new ideas or on the basis of recommendations from the deans of the colleges and schools. After the series of luncheons had concluded,

Provost Anderson recommended nine persons whom Chancellor Hathaway then appointed to an Information Technology Committee.

The mission of the Information Technology Committee had two components. First, the Committee was asked to determine reasonable expectations for prospective employees in Arkansas' information technology industry. Second, the Committee was charged with putting those competencies in a curriculum framework suitable for an undergraduate minor in information technology.

The Committee developed six operational goals. These goals were as follows:

1. Develop a data gathering strategy to determine desired and needed competencies of employees in the information technology industry in Arkansas in a manner that assured these industries that UALR was listening and responsive to industry needs.
2. Determine the competencies that could reasonably be expected for a number of specific functions in the information technology industry and confirm these competencies with professionals in the industry.
3. Produce a formal report of the findings of the Committee on information technology work force needs.
4. Prioritize the desired competencies into a list of those that might be included in a self-contained information technology minor for students involved in non-technical majors.
5. Coordinate in cooperation with industry and partner universities (ASU, Harding, Hendrix, Ouchita Baptist, Philander Smith, and UA-Pine Bluff) the development of the minor in information technology. Development, if possible, a summer program involving a portion of the minor that would allow students at the partnership institutions to undertake this minor partly on the various campuses and partly in the summer at UALR.
6. Develop potential screening and admission processes for the information technology minor.

This report represents the completion of the first three of these goals. In the course of its work, the Committee sought and received help from information technology companies of Central Arkansas, from a number of University colleagues, and from others. The Committee wants to express our gratitude to them. Our only concern in this public acknowledgment is that it is probably inevitable that the Committee shall omit the name of someone who deserves to be included.

Representatives of Central Arkansas information technology companies were very helpful to the Committee in organizing and arranging site visits, allowing it to see first hand the business of near-by IT operations. These persons served as our liaisons with the IT industry throughout this experience. Without their kind assistance and support, this project could not have succeeded. They are, in alphabetical order by last name: Tom Allen, Inacom Information Systems; Cindy Childers, Acxiom Corporation; Rod Ford,

Leader of the ESI Group; James Hendren, former CEO of ArkSys; and Brian C. Neal and his predecessor at Alltel, Allison Nicholas.

Ron Roberts, BEI Systems CEO and President of the Knowledge-Based Companies of Arkansas, helped the committee keep the Arkansas IT community informed and involved during this project. Through his organization's networking capabilities, the Committee was able to involve many companies outside Central Arkansas in our Web Survey.

Catherine O. Lowry, Instructor of Speech Communications and Director of UALR's Baum Decision Support Center not only facilitated our focus groups with Central Arkansas IT Companies, but also spent an entire day working with the Committee to organize the responses from the focus groups and shape the information into a survey instrument.

Patrick R. Pearce, Systems Analyst in Computing Services, spent many hours helping the Committee install, publish, and field-test our Web Survey. In addition, Pat has devoted countless hours developing this web-based report. The document formatting style sheets that make these pages attractive were Pat's creation. He also is responsible for most of the HTML coding that allowed the Committee to transform word processing documents into web pages.

Finally, the Committee wishes to thank UALR Chancellor, Charles E. Hathaway, and Provost Joel E. Anderson. Dr. Anderson's broad perspective on the curriculum process and his insistence that the Committee be innovative in gathering data and in developing the new program curricula have served us well. His background notes on the historical aspects of this project contributed significantly to this report.

Chancellor Hathaway attended most of our Committee meetings, and his contributions and suggestions were extremely helpful. Dr. Hathaway provided moral, financial, and personal support. He has been our counselor, advocate, and friend. He was the initial contact between UALR and the chief executives of the information technology companies. Most of all, Chancellor Hathaway brought to the Committee an excitement and a challenge to reach beyond the bounds of institutional tradition. The Committee believes Chancellor Hathaway will make good on his promise to make UALR the "Star Ship" of the University of Arkansas System.

Janet L. Bailey
John Faucett
Nickolas S. Jovanovic
Pete Tschumi
Gretchen B. Watson
Don D. Cherepski
Robert J. Hines
Thomas A. Teeter
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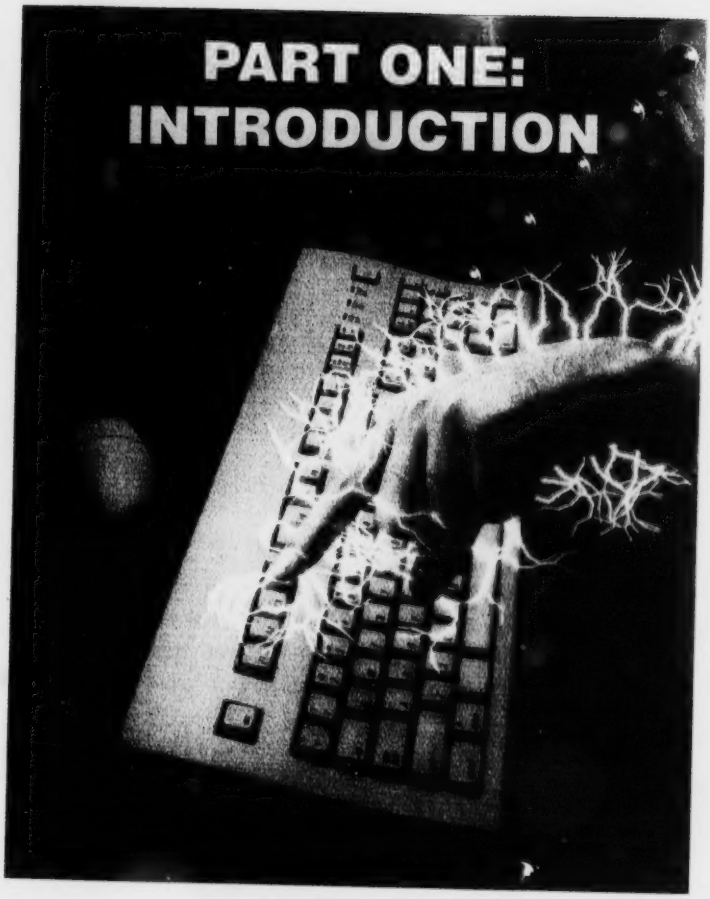
A web version of this report can be found at www.ualr.edu/~itreport



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PART ONE: INTRODUCTION

Overview of Study

In developing a data gathering strategy, the Committee viewed it to be of critical importance to insure that the process truly determined the needs of the information technology industry and to absolutely assure the industry that the Committee were really listening to their needs and doing everything possible to respond to those needs. As a result, the collection of data followed a multi-step process with industry input at each stage. After each step in the process, the Committee also asked industry to examine and validate our results.

The process began with site visits to a few select companies in the central Arkansas area. For these visits, members of the Information Technology Committee met with a few key executives at each company. These meetings identified types of jobs in information technology for entry-level personnel with a college degree. Furthermore, the initial formulation of the knowledge, skills, abilities, and tasks for each job type was begun.

An analysis of the initial data developed generic job clusters, common among the companies interviewed. This analysis also established the basis for the second phase of data collection. The second phase brought employees experienced in the various job types to the UALR campus for focus groups. Phase two allowed for in-depth development of the knowledge, skills, and abilities for each job type.

From the data developed in phase two, the Committee developed a survey, which was posted on the World Wide Web. The survey consisted of four main sections: one to capture basic demographic information; the second on non-technical soft-skills (writing and teamwork); the third on business concepts; and the fourth on technical knowledge, skills, and abilities. The fourth area on technical knowledge was further subdivided into eight job clusters:

- Computer Programmers
- Systems/Business Analysts
- Computer Engineers
- Database Administrators
- Computer Support Specialist
- Network Specialists
- Telecommunications Analysts
- Internet Specialists

In subsequent sections of this part of the report, detailed discussions of each of the phases can be found. The companies that participated in the initial site visits and focus groups are described in Part Two of the report. In Parts Three, Four and Five, this report presents a detailed analysis of the data collected from the web survey.

Phase One: Company Site Visits

During this phase, two teams of four or five members of the Information Technology Committee visited a total of five information technology companies: Acxiom, Alltel, ArkSys, ESI Group, and Inacom. Chancellor Hathaway initiated these visits by first contacting the companies via mail and e-mail, requesting their support and involvement. The committee then contacted the companies by phone to ask them to identify who in their organization would be in the best position to identify people familiar with the knowledge, skills, and abilities of entry level people. In general, these individuals were first-line supervisors, training directors, and, in a few cases, senior management. Prior to the visits, the committee sent a follow-up e-mail describing the process and listing questions that would guide the visits.

While a great deal of flexibility was allowed in the visits, an important aspect of the Committee's success came from organizing each team so that each member filled a particular role during the meetings and so that all of a predefined set of questions were answered. Frequently, team members participated in a variety of other roles. The four prescribed roles were facilitator – insured that the team process works and kept the discuss on task, "what about" questioner – insures that all the questions were asked, Probe questioner – insured that issues related to a question were probed thoroughly, recorder – kept a written record of all questions and answers.

The agenda for the visits followed this sequence:

- Introduction of participants
- Define expected outcomes of the meeting and purpose of overall study
- Open discussion of questions
- Discuss next stage of the study, and ask for help in identifying key employees who are knowledgeable about the knowledge, skills, and abilities needed for each type of job identified, for participation in focus groups
- Summation of the meeting's results

The questions used to direct the discussion were

1. What type of work does your company do?
2. What kinds of jobs do you have in the company, and what type of education would be appropriate for these positions?
3. If you had to divide each of the jobs into four or five major job functions, what would they be?
4. What type of person would you most like to see in this organization?
5. Considering the kinds of jobs that you believe will be important in the next 5-10 years, what do you think will be the knowledge, skills, and abilities needed for those jobs?

In addition to the above questions, a few more specific questions were always asked related to such issues as what software packages were used, what programming languages were used, and what interactions employees had with others both within and outside the company.

Based on the information collected from these visits, the committee identified eight job clusters. In addition, two areas of knowledge, skills, and abilities were identified that are needed across all the job clusters. These two areas are soft skills and business concepts. The soft skills include such abilities as being able to function well in a team environment, problem solving, time management, writing, speaking, and so forth. The business concepts include project management, "be the customer mentality," accounting, marketing, etc. The eight job clusters are shown below with a brief description of what each job does.

- **Computer programmers** write, test, and maintain programs that computers must follow to perform their functions. This cluster includes applications programmers for both mainframe and client/server, who write software for jobs within an organization, and systems programmers, who maintain and control computer systems software.
- **Systems/Business analysts** study business, scientific, or engineering data processing problems and use computers to design solutions.
- **Computer engineers** design and develop new hardware and software. Software engineers develop software systems for control and automation in manufacturing, business, and other areas.
- **Database administrators** set up computer databases and test and coordinate changes to them and determine ways to organize and store data.
- **Computer support specialists** provide technical assistance, support, and advice to clients and users, such as software services consulting.
- **Network specialists** design, install, and support an organization's distributed computing (LAN, WAN, network segment, or Internet system). Network and data communications analysts design, test, and evaluate network systems and perform modeling, analysis, and planning.
- **Telecommunications analysts** focus on the interaction between computer and communications equipment.
- **Internet specialists** are involved in the design, development, and maintenance of Web sites and their servers. Typical jobs include webmasters, who are responsible for all technical aspects of the Web site, and web developers, who are responsible for site design and creation.

After clustering the interview information into these ten categories, the Committee then checked with the companies to validate our results. Once this validation was complete, the study moved into phase two.

Phase Two: Focus Groups

For phase two of the study, the Committee convened two focus groups on the University of Arkansas at Little Rock campus. The Baum Decision Support Center was used to facilitate this next stage of data gathering. The Baum Center is available for UALR activities as well as for activities of companies and other entities outside the University. It is an electronic meeting room with each participant sitting at a computer.

Participants can type entries on their own station before submitting them to a central screen. The central screen lists everyone's entries. The central screen is projected onto a screen at the front of the room or can be viewed on each computer. This arrangement allows each person to express his or her ideas simultaneously and anonymously. As a result, the Baum Decision Support Center provides excellent support for focus groups, creative problem-solving, electronic brainstorming, conflict resolution, planning sessions, etc. In addition, the Center provides a trained moderator to guide sessions. Catherine Lowry served as our moderator for all of our activities in the Center and contributed greatly to our success.

In forming the focus groups, the Committee asked the same companies that had participated in the site visits to provide it with a few individuals who had a good understanding of the knowledge, skills, and abilities needed for entry-level information technology jobs at their respective company. In particular, the Committee wanted individuals, who had worked in these jobs, and managers, who had directly supervised employees, engaged in these jobs.

For each of the focus groups, the Committee first explained the study. Next, the purpose of the focus groups and the manner in which they were to be conducted were explained. Then data was collected for each of the ten categories: soft skills, business concepts, computer programmers, systems/business analysts, computer engineers, database administrators, computer support specialist, network specialists, telecommunications analysts, and Internet specialists. For each category, the Committee asked the participants first to list all of the knowledge that an entry-level employee needed to be effective. Then the Committee asked them to list the skills and abilities an entry-level employee needed. These focus groups generated a large amount of data for the ten categories.

After collecting this data, the Committee then used the Baum center to distill the data into a more refined list of knowledge, skills, and abilities for each of the ten categories. This list became the basis for the survey the Committee implemented in phase three of the study. Before implementing the survey, the Committee asked others on campus to check the list for completeness and to check the format of the survey to insure that it was designed well.

Phase Three: World Wide Web Survey

Using WebSurveyor, the survey was posted to the web. The survey was organized first to collect from all participants some basic demographic information, then their evaluation of the items in the soft-skills category and the business-concepts category. To evaluate an item, they were to choose one of five levels of importance: extremely important, very important, somewhat important, not very important, and not important at all. Within each category, the survey listed first the knowledge items and then the skills and abilities items. Participants were then given a menu that allowed them to choose which job category they wanted to evaluate. At the end of each category, they could either go to the end of the survey and submit their answers or go back to the job category menu and choose another job category to evaluate. A copy of the survey appears in the Appendix.

The analysis of this survey comprises most of this report. The demographic results immediately follow this section in Part One. The analysis of the non-technical soft-skills is in Part Three. The analysis of business concepts is in Part Four. In Part Five, each of the job clusters under technical knowledge, skills, and abilities is analyzed separately.

Survey Demographic Information

Basic Demographics

The 309-item survey was administered via WebSurveyor (a web-based survey software package) for a period of approximately three weeks. A total of 359 respondents answered questions about their demographics and then a variety of questions about desired characteristics for entry-level information technology employees with bachelor degrees. All respondents rated the importance of various soft skills and business skills. They then chose one or more of the eight-job cluster categories that they felt they had expertise in and rated the importance of various characteristics for these areas.

Employees of sixteen information technology companies in central Arkansas responded to the survey. These companies were Acxiom, Alltel, Aristotle, Arkansas Science and Technology, ArkSys, BEI Sensors and Systems, CD Resources, Connect4Business, Custom MicroSystems, Department of Information Systems (State of Arkansas), EDS, ESI group, Inacom, Innovative Solutions, Southwestern Bell, and USNR-Hemco Division.

Regarding 'the highest level of education achieved' by the respondents to the survey, a majority identified themselves as having a bachelor's degree (58%). (See Figure 1). Other respondents (listed in descending order) identified themselves as having a master's degree (17%), associate's degree (10%), post high school technical training (4%), doctoral degree (2%), and high school degree (2%). Approximately six percent of respondents chose the 'other' category. These individuals included responses such as military education, college education without graduating, and graduate education without obtaining the terminal degree. (It should be pointed out that all percentages reported in this section are rounded off to the nearest whole number.)

Respondents also indicated their academic major (or primary concentration of study) while in college. There was a wide array of responses representing the diversity of programs typically offered at colleges and universities. A sampling of majors of the respondents includes accounting, biology, business, chemistry, computer science, education, English, engineering, finance, journalism, marketing, mathematics, music, nursing, pharmacy, political science, psychology, physics, religion, sociology, statistics, technology, and zoology. While there was a tendency for many respondents to have a computer/technical background, it is clear that information technology companies hire people from a wide range of educational backgrounds, including business, the natural sciences, arts, humanities, and social sciences.

Respondents were asked to indicate which of the eight job clusters best described their area. (See Figure 2.) The percentage of respondents in each of the clusters, in descending order are as follows: computer programmers (47%), systems/business analysts (24%), database administrators (9%), computer support specialists (6%), network specialists (5%), computer engineers (3%), Internet specialists (3%), and telecommunications analysts (2%).

There is a somewhat even distribution of primary computer programming languages used regularly in the information technology firms of central Arkansas. (See Figure 3.) Respondents could make multiple responses to this question. In descending

order, this list is SQL (20%), 'C" (15%), 'C++' (14%), COBOL (12%), HTML (12%), Java (5%), RPG (4%). Nineteen percent of respondents also chose the 'other' category and typed in their own responses. Although most of these responses were only represented once, two of the responses received a high number of entries. They were Assembler (25 respondents) and Visual Basic (43 respondents).

Respondents also were asked about the primary operating systems that are used by their company. They could make multiple responses to this question. Responses (in descending order) were Windows NT (26%), Windows 95/98 (26%), Main frame (23%) Unix (22%), and Mac (1%). Nine percent of respondents chose the 'other' response and typed in their answer. Multiple entries to this 'other' response were OS/400 (23 respondents), Novell (5 respondents), and Linux (3 respondents).

Organization of Figures in This Report

In the sections that follow, the results of respondents to the major categories of the survey are presented. The summary figures presented in each of these subsections are organized in the same manner. The job-related characteristics presented on each figure are listed in descending order, according to how desirable the group of respondents rated them (for an entry-level employee with a bachelor's degree). Each figure shows how many respondents rated the characteristic as either Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important at All (NI). The characteristics are sorted primarily according to median response. It must be pointed out that a lower median score (i.e., '0') corresponds to a higher rating (i.e., Extremely Important characteristic). A secondary sort also was performed on the characteristics listed in each figure. This sort was performed on a number that was calculated to represent the importance of the characteristic. To accomplish this, the average number of respondents for the Extremely Important and Very Important responses were averaged. Finally, the last column of each figure (N) lists the number of responses for each characteristic.

PART TWO: FOUNDATIONS

PART TWO:
FOUNDATIONS

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PART TWO: FOUNDATIONS

IT Companies in Central Arkansas

Five Central Arkansas high technology companies allowed the UALR Information Technology Committee to conduct on-site interviews. These visits were the Committee's beginning step in determining the skill set and the basic core of knowledge that these companies seek in entry-level employees.

The data gained during these site visits were used to organize subsequent focus groups of IT employees and ultimately to develop and place on the World Wide Web an extensive survey instrument to gather information from desk-level IT employees. Collectively, the site visits, focus groups, and Web survey helped the Committee define core competencies, characteristics, and behaviors that companies expect in eight information technology job clusters.

The companies that hosted site visits were Acxiom, Alltel, ArkSys, ESI Group and Inacom. What follows is a brief description, of each of these organizations, including the company history, company direction, and a sampling of positions normally available for prospective employees.

Acxiom Corporation

Acxiom Corporation is an international company with corporate offices located in the city of Conway in central Arkansas, with other locations throughout the United States, Canada, the United Kingdom, France, the Netherlands, and Malaysia. Acxiom provides international customers with a wide range of data products, data integration services, mailing list services, modeling and analysis, and information technology outsourcing services. Acxiom also provides data warehousing and decision support services for major companies around the world.

Acxiom has become a major force in the direct marketing community. Acxiom's primary business thrusts are in the area of Data Content; Data Integration, Management, and Delivery; and Information Systems Technology. Acxiom's leadership in Data Content is the result of numerous data acquisitions and the establishment of many industry partnerships and alliances. Acxiom's leadership in Data Integration, Management, and Delivery comes from its ability to accept any input format, to identify or parse the pieces of data, and to cleanse and standardize the data values. All of this information is now made available to the business desktop environments.

Acxiom's leadership in Information Systems Technology comes from their ability to combine open database platforms with the best software applications based on individual client needs. This, along with the ability to use parallel processing to the clients' advantage, keeps them a leader in their field.

Employing 3,600 employees or associates worldwide, Acxiom is constantly looking for new information technology talent. Acxiom is a results-oriented company

whose new employees become productive, almost immediately. Another benefit of employment at Acxiom is the exposure to specialized and continual training. In addition, employees work in what has been defined as a "casual atmosphere," which even defines its dress code. Some examples of the types of positions for which Acxiom regularly searches are as follows:

Account Service	Marketing Analysis
Research Analysis	Software Engineering
Technical Hardware Support	Technical Writing
Computer Operations	Data Administration
Database Administration	Database Systems Analysis

Alltel Corporation

Alltel Corporation is a company of both a national and international proportions. With a customer base of over 5.6 million customers, Alltel serves 22 states with its wireline and wireless communications services and serves 48 countries with its information services. Alltel serves financial, mortgage, and telecommunications clients the world over. Alltel is a Forbes, Fortune, and S & P 500 company.

Alltel Corporation began business as a wireline telecommunications company, serving the needs of local telephone customers. In the 1980's, Alltel moved into the burgeoning field of wireless communications with the establishment of Alltel Wireless Services. Today, the communications arm of Alltel has begun providing customers with local and long distance, Internet access, and network management services.

In 1990, Alltel expanded its horizons with the acquisition of a company formally know as Systematics. With its acquisition, Alltel moved into the Information Services market. Alltel felt as the line between voice and data communications began to blur, it would be to their customers' advantage for the company to add Information Services to their ever-growing list of products and services. The Information Services division offers technology solutions, such as Complete Information Technology Outsourcing, Network Services, Wholesale and International Banking Software, Business Analysis and Software Development, Customization, Maintenance and Production Support, just to name a few. In addition, Alltel Information Services provides Alltel wireline and wireless clients complete end-to-end information processing solutions.

Alltel is constantly on the search for potential information technology-knowledgeable applicants. Due to the diversified nature of the Alltel Corporation, a broad range of careers are available to IT students. Some examples of typical available positions include:

Client/Server Developer Analyst	Operating System Consultant
Product Specialist	Systems Specialist
Systems Programmer	Dist Systems Analyst
Database Administrator	LAN Support Specialist
Development Analyst	Software Applications Analyst

ArkSys

ArkSys is a wholly owned subsidiary of Euronet Services, Incorporated, and headquartered in Little Rock, Arkansas. It is a premier provider of effective payment and financial transaction delivery systems. The company offers comprehensive ATM, POS debit and smart card packages, EFT network solutions, interactive voice response, international credit card systems, and Internet and Intranet cash management, home banking, bill payment, and presentation offerings.

As a recognized leader in providing comprehensive payment and transaction delivery management solutions, ArkSys' software is installed in over 70 countries with hundreds of active clients. Since 1975, ArkSys provided solutions for its customers, designed to help increase client revenues and market share. ArkSys provides many products with which to solve client problems. Under the category of Card-Based Solutions, ArkSys provides solutions for ATM Systems, International Credit Card Systems, Debit Card Systems, POS Systems, and Card and Client Management.

ArkSys also provides solutions for Electronic Financial Transactions networks, such as products and services for EFT Network Connections and EFT Network Solutions. The Retail Delivery Market is still another area in which ArkSys is ready to meet its clients' needs. In addition to the previously mentioned services, ArkSys also provides products for Integrated Merchant Systems. With over twenty years of experience, ArkSys has continuously provided systems solutions to many of the world's financial management problems.

To continue to fulfill client needs, ArkSys is constantly on the watch for qualified employees to join their family of information technology specialists. Some areas of special interest to ArkSys are as follows:

Software Design	Development
Installation	Customer Support
Human Resources	Quality Control
Product Management	

ESI Group

ESI Group is a major Arkansas-based information technology company that started out ten years ago installing automated manufacturing systems with two employees. Now, ESI Group employs 160 associates and serves more than 800 clients, installing over 2000 projects. What began as a two-man company has evolved into a business generating 25 million dollars in revenues.

Although headquartered in Arkansas, ESI Group has spread its wings across our country to Alaska and internationally to such countries as Canada, Mexico, Argentina, and South Africa.

ESI Group operates with three Core Competencies as its base. These include Infrastructure, Application Development, and Consultation. In this way, the ESI Group

provides its customers with complete information technology solutions, from designing and installing the physical infrastructure to developing custom software for the operation of the system, and ultimately to providing direction in acquiring the human elements to manage the system.

To accomplish its corporate goals, ESI Group has formed alliances with some of our country's technology leaders. These include such organizations as Oracle, Hewlett Packard, Compaq, Microsoft, and Lucent Technologies, just to name a few. With such technology partners, the ESI Group provides expertise in solving a wide range of client problems.

To provide such solutions also requires the finest base of human knowledge. This base is founded on an entirely new approach to a corporate structure - namely, the development of a new "culture" in running and doing business. This "culture" is defined by the very people who come together to form the ESI Group.

Unlike many organizations, the culture of ESI does not limit the "decision-makers" to the top of the corporate ladder. All associates are required to be decision-makers and team members. It is this approach, along with the expectation that all employees can be leaders, that gives the ESI Group its unique position in the corporate community. In looking for new associates to join the culture of the ESI Group, the following positions are examples:

Information and Telecom Consultants	Telecommunications Engineer
Automation Engineer	Application Development
Datacom Technicians	Electrical Technicians
Project Management and Estimation	Cabling Systems Designers
Business Development: Infrastructure and Integration	

Inacom

Inacom is a global technology management services company founded in 1982. Inacom supplies services to manage the life cycle of information and telecommunications technology to businesses around the world. Inacom assists clients as they design, procure, build, install, and manage their distributed environment.

More recently, Inacom merged with Vanstar Corporation to create a seven billion-dollar company with more than 12,000 employees. This transaction will create a leading technology services company while also becoming a provider of computer products to the industry's largest customer base.

Inacom Information Systems in Little Rock, Fayetteville, Fort Smith, and Tulsa are part of the Inacom network of technology management services providers and employ the most skilled and highly trained IT Professionals available in our market. From the Professional Services team to the Account Executives and Sales Support team, Inacom's goal is to provide the highest level of service to its clients. This philosophy extends from the local owner/managers to the back office. Its position as a long-term player in the industry is supported by its core commitments to long-range strategies and its employees' relentless focus on client satisfaction.

The business philosophy of Inacom is to provide clients with "service before"- assessing their needs, "service during"- keeping the systems up and running, and "service after"- making sure systems are running at peak efficiency.

This is accomplished through Inacom's Integrated Life Cycle Management Service Approach. The five cornerstones of this approach include: Technology Planning - planning the right system for the client, Technology Procurement - expeditiously procuring the right system for the client from vendors, Technology Integration - seamlessly integrating new technology with existing systems, Technology Support - maintaining the client system at peak operating levels, and Technology Management - assisting clients in proactively managing their entire networks. This approach is based on the Inacom attitude that "Running Is Everything." "If you are not up and running, you're nowhere."

In the employment market, Inacom provides broad-based opportunities for those seeking employment in a technology-based industry. Offering a comprehensive and selective employee benefits package, Inacom is one of the industry's key employers. The broad range of employment opportunity includes such positions as:

Account Executive	Network Administrator
Client Services Representative	Desktop Services Technician
Network Systems Engineer	Project Manager

The Spectrum of Computing Sciences Programs at UALR

One of the purposes for collecting data about the work force needs of knowledge-based companies in Arkansas is to shape the curriculum development process for newly created programs at UALR. The goal is to create curricula that enable college students to gain knowledge, skills, and abilities that are valued by knowledge-based companies. The data also may be useful for revising curricula in several existing programs at UALR. The spectrum of computing sciences programs at UALR that will be shaped by this data ranges from highly technical computer engineering and technology programs to business applications-oriented information science programs, with a computer science program in the center.

Computer Engineering Technology	←	Computer Systems Engineering	←	Computer Science	→	Information Science and Technology	→	Computer Information Systems

The Computer Information Systems program is offered by the UALR College of Business Administration, while all of the other programs are offered by the newly created UALR College of Information Science and Systems Engineering.

College of Information Science and Systems Engineering

The College of Information Science and Systems Engineering (CISSE) was unanimously approved by the University of Arkansas Board of Trustees on December 10, 1998, and approved by the Arkansas Department of Higher Education on February 5, 1999. The Arkansas General Assembly enacted appropriations legislation for CISSE on March 24, 1999 (Act 808 of the 1999 Regular Session).

CISSE comprises four departments: a new Department of Systems Engineering, plus the existing Departments of Computer Science, Engineering Technology, and Applied Science. In addition, CISSE will house new interdisciplinary programs in Information Science and Technology.

Programs in Information Science and Technology

The College of Information Science and Systems Engineering will offer an interdisciplinary Bachelor of Science degree in Information Science and an upper-level stand-alone undergraduate minor in Information Technology. The minor is intended for students who are majoring in a field not having an intensive-computing component.

Department of Systems Engineering

The Department of Systems Engineering will offer a Bachelor of Science degree in Systems Engineering. As soon as the requirements can be met, UALR will seek accreditation by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC-of-ABET) for this degree program. The program will initially offer two tracks: Telecommunications Systems Engineering and Computer Systems Engineering.

Department of Computer Science

The Department of Computer Science offers an Associate of Science degree in Computer Programming, a Bachelor of Science degree in Computer Science, and a Master of Science degree in Computer Science. The Computer Science Accreditation Commission of the Computing Sciences Accreditation Board accredits the Bachelor of Science degree program.

Department of Engineering Technology

The Department of Engineering Technology offers Associate of Science degrees in Electronics Engineering Technology and Mechanical Engineering Technology, and Bachelor of Science degrees in Electronics Engineering Technology, Mechanical Engineering Technology, Computer Engineering Technology, and Construction Management. A Bachelor of Science degree program in Surveying and Land Information Systems also exists, but is suspended and not currently enrolling new students. All of the engineering technology degree programs are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC-of-ABET), while the Construction Management degree program is accredited by the American Council for Construction Education.

Department of Applied Science

The Department of Applied Science offers Master of Science and Doctor of Philosophy degrees in Applied Science. In addition to offering a stand-alone graduate program in instrumental sciences, the Department of Applied Science also serves as an umbrella graduate program for the other departments in CISSE, as well as for departments in the College of Science and Mathematics, i.e., Physics and Astronomy, Chemistry, Biology, Mathematics, and Earth Science.

College of Business Administration

The College of Business Administration comprises four departments: Accounting, Economics and Finance, Management, and Marketing and Advertising. The College of Business Administration offers baccalaureate programs in ten areas of concentration, as

well as a Master of Business Administration degree. The American Assembly of Collegiate Schools of Business accredits all College of Business Administration programs.

Department of Management

The Department of Management offers a Bachelor of Business Administration degree in Computer Information Systems.

PART THREE: NON-TECHNICAL, SOFT SKILLS

PART THREE:
NON-TECHNICAL, SOFT-
SKILLS

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PART THREE: NON-TECHNICAL, SOFT-SKILLS

Introduction

In describing their employment needs, information technology companies presented a number of different job titles that required very diverse technical skills. However, all companies listed virtually the same non-technical or soft skills as important. Because of the pervasive nature of these characteristics, the Committee felt that *knowledge and abilities* needed prominent display in the report and deserved a separate section.

Findings

Approximately 324 people participated in the non-technical, soft-skills section of the survey. The number of respondents to an individual item ranged from 322 to 325. As shown in the table below, twenty items were identified as knowledge and abilities needed for entry-level positions in information technology. Tables presenting the non-technical, soft-skills rankings, based on the job cluster within which the respondent classified himself or herself, are found in the appendix III.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

The first table shows that 8 items had a median of 0 or 1(Extremely High or Very High) and an Importance Average of greater than 140. These items are considered

"Highly Desired Characteristics." The most important characteristics are excellent problem solving abilities, the ability to listen, the ability to function as a member of a team, and the ability to adapt to new technology and new languages. Pie charts of the top four items can be seen in Figures 4 through 7 in Appendix II. Time management and verbal communication are also important characteristics.

SOFT SKILLS									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Problem solving process (decision tree, problem identification, analysis, solving)	196	109	16	3	0	0	152.5	324
2	Listening	153	152	18	0	0	0	152.5	323
3	Team Work (long term)	154	148	22	1	0	0	151.0	325
4	Adaptability to new technology, new languages	154	143	27	1	0	0	148.5	325
5	Transferring knowledge to application	115	179	29	1	0	1	147.0	324
6	Time management	128	162	33	2	0	1	145.0	325
7	Visualize/conceptualize	111	173	41	0	0	1	142.0	325
8	Verbal Communication	111	171	41	1	0	1	141.0	324

Table 1 – Soft Skills, Highly Desired

The items in the second table can be described as "Desired Characteristics." These eight items all have a median of 1 with an Importance Average of greater than 102 and less than 138. Given the high median value all of these items should be considered necessary characteristics of entry-level positions in information technology.

SOFT SKILLS									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
9	Ability to multi-task	135	140	45	5	0	1	137.5	325
10	Business culture (priorities, schedules, self-initiating)	90	172	56	6	0	1	131.0	324
11	Inter-team communication	72	190	58	3	0	1	131.0	323
12	Interpersonal skills	73	183	65	4	0	1	128.0	325
13	Constructive criticism (delivery and receipt)	86	166	67	5	0	1	126.0	324
14	Organizational skills	62	185	74	2	0	1	123.5	323
15	Stress management	73	155	84	10	2	1	114.0	324
16	General writing skills	47	158	111	7	0	1	102.5	323

Table 2 – Soft Skills, Desired

The set of items in the last table can be described as "Less Desired Characteristics." These four items have a median of 1 or 2 with an Importance Average of less than 94. While leadership ability is still very important, technical writing barely receives a median of 1. The other two items, diversification (different cultures) and good presentation skills, receive the only median scores of 2 in the soft-skills category.

SOFT SKILLS									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
17	Leadership (interactions with peers, servant leadership)	40	147	126	11	1	1	93.5	325
18	Technical writing	28	138	138	18	2	1	83.0	324
19	Diversification (different cultures)	21	91	143	56	14	2	56.0	325
20	Presentation skills	17	93	174	37	1	2	55.0	322

Table 3 – Soft Skills, Less Desired

Conclusions

People with both technical skills and soft skills enjoy unlimited opportunities with the knowledge-based companies. Similarly, these companies offer people with substantial soft skills, but minimal technical skills, the same opportunities. Several firms, including Alltel and Acxiom, indicated that a place would be made for individuals who possess minimal technical skills but demonstrate initiative, leadership ability, and a willingness to learn and adapt. Rod Ford, President of ESI Group, suggested that the minor be designed around the soft skills instead of technical skills.

It was suggested that students enrolled in information technology-related curriculum participate in intern projects that require at least a semester to complete. These projects should center around the two most important soft skills, teamwork and problem solving, but include other desirable soft skills as well. These projects would demonstrate the criticality of interpersonal skills to establish relationships within the team and between the team and its client. Understanding the needs of a customer, examining the needs holistically, and visualizing a solution for those needs would be skills participants could later use in the workplace. Students would realize the constraint of deadlines. They should see how important effective communications are to both team and client relationships. Frequent changes in technology would test the adaptability of participants. Mastering new languages, new software, and hardware would be a continuous challenge.

The university should make an effort to see that all UALR students receive information about the soft skills required for information technology careers. Students preparing for these fields need to take advantage of courses across the curriculum that would build their soft skills. Cooperation within the entire campus will be needed if UALR is to produce graduates who can fill the employment needs of knowledge based companies. Faculty can participate actively by listening to the needs of business and incorporating soft skills within their discipline.

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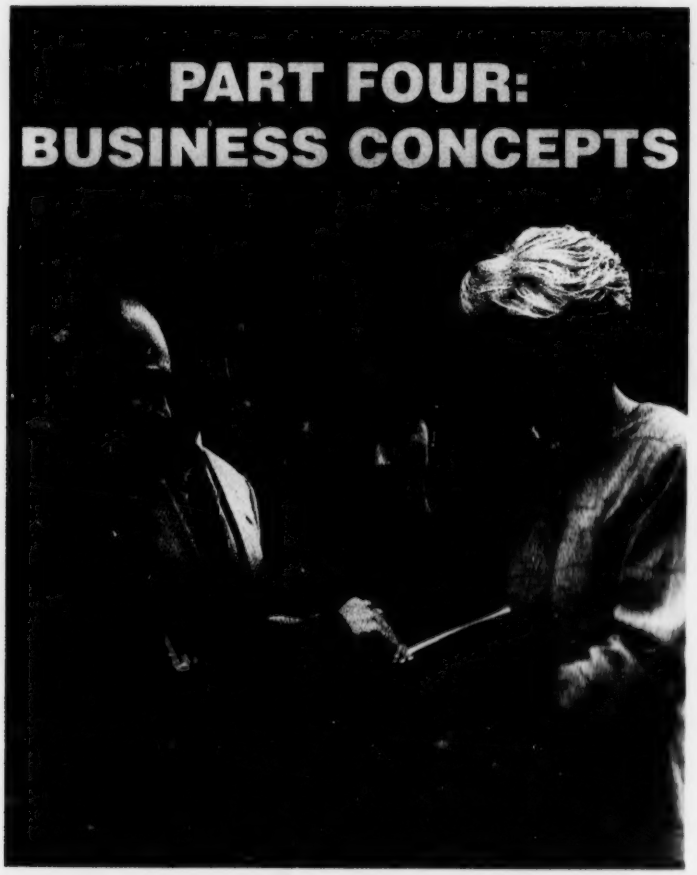

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PART FOUR: BUSINESS CONCEPTS

Introduction

Twelve business skills were identified as part of the important skill set of the IT professional. Collectively, these skills represent the abilities to investigate, understand, and manage the IT professional's work environment. Seven on the list involve people skills, one relates to marketing, and the other four involve understanding of accounting principles. The group of people skills on the list are closely related to the soft skills presented in the previous section. However, they are more directed at the ability to incorporate the individual's soft skills into the successful management of business activities.

The majority of the skills presented are self-explanatory. For those that are not, the following provides a brief explanation.

Investigative skills involve asking probing questions for needs assessment and troubleshooting tasks. This skill set involves the individual's ability to act as a detective. During the focus groups, the discussion centered around the ability to recognize when an answer is too broad and needs further clarification, the ability to identify where answers can be found, and the ability to ask the right type of questions to uncover the answer. Often the answer depends on a series of events that has lead to a problem.

The person's interviewing skills significantly enhances investigative skills. Interviewing skills require communicating with the user for needs assessment but do not always require the detective skills associated with investigating.

"Be the customer" mentality is the ability to see things from the customer's point of view. Key to the success of an information system is recognizing that the customer is the expert at their particular job, and that the system should work for the customer rather than the other way around. Furthermore, when an information systems professional looks at a problem or opportunity from the customer's perspective, they are able to work as a team with the customer to develop better business solutions.

The information systems professional is critical to meeting the user's needs, both before and after implementation. Frequently, problems arise in the technological environment, and when they do, customers can quite often become agitated. Mediation skills involve being able to calm and reassure these upset users. This skill set requires that the IT professional respect the user's point of view, identify the source of the stress, and successfully resolve the problem while assuring the user that everything will be okay. During this process, the IT professional often has the opportunity to provide a limited amount of training to the user about how to deal with the situation should it arise again.

Idea initiation involves being able to be creative in problem-solving and opportunity-creating situations. The participating organizations expressed the desire to hire employees who show initiative. They are looking for talented individuals who can and will contribute to the overall brainpower of the organization.

Findings

Approximately 322 people participated in the business concepts section of the survey. The number of respondents to an individual item ranged from 320 to 324. As shown in the tables below, there were twelve items that were considered important for all IT'professionals. These twelve items represent the knowledge and skills, identified through on-site interviews and focus groups within the Knowledge Based Industries in Arkansas.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Tables presenting business skills rankings, based on the job cluster within which the respondent classified himself or herself, are found in the appendix IV. The data in the job cluster tables indicate the ratings of these twelve business skills by all the individuals whose job function fell within that cluster. These skills may not, therefore, be representative of the skills that are needed by a particular job cluster. They are, however, at a minimum, skills that are perceived as needed for mobility within job clusters.

Discussion

As reflected in the table below, there are four characteristics with a median value of 1 (Very High) and an Importance Average of greater than 94. The data indicate the four skills as the most "highly desirable" are "be the customer mentality," investigative skills, idea initiation, and project management. Pie charts of the top four items can be seen in Figures 8 through 11 in Appendix II. Each of these skills also rank in the top four for each job cluster, although the data indicates that investigative skills are not quite as critical to an Internet specialist as they are to the rest of the clusters. Interviewing skills appear as a fifth "highly desirable" skill for computer engineers and mediation skills appear as a fifth "highly desirable" skill for telecommunication analysts.

BUSINESS CONCEPTS									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	"Be the customer" mentality	96	158	62	6	1	1	127.0	323
2	Investigative skills (probing questions)	97	153	63	10	0	1	125.0	323
3	Idea initiation	55	157	99	8	2	1	106.0	321
4	Project Management	54	135	108	23	4	1	94.5	324

Table 4 - Business Skills, Highly Desired

The next set of characteristics can be described as "Desired Characteristics." These five skills are viewed as important, although they are not viewed as important as the first set. These all have medians of 2 and an Importance Average from greater than 20.5 to less than 49.

BUSINESS CONCEPTS									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
5	Interviewing skills	28	70	126	72	26	2	49.0	322
6	Mediation skills	9	70	168	69	8	2	39.5	324
7	Use of capital (risk and return)	2	43	126	119	33	2	22.5	323
8	Role playing	6	37	133	115	33	2	21.5	324
9	Marketing	9	32	136	110	34	2	20.5	321

Table 5 - Business Skills, Desired

The last set of characteristics can be said to be "Less Desired." These three characteristics rank the lowest for all groups. Two of the three have medians of 2 and Importance Averages of 18.5 and 17.5 respectively. The third, reading a balance sheet and income and expense summary, has a median of 3, "Not Very Important," and an Importance Average of 9.5. All three of these skills are accounting functions indicating, perhaps, that fewer IT positions necessitate accounting skills than were necessary in the past.

BUSINESS CONCEPTS									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
10	Reading a budget (and understanding)	4	33	112	136	35	2	18.5	320
11	Basic accounting	9	26	122	117	48	2	17.5	322
12	Reading a balance sheet and income and expense summary	2	17	99	147	58	3	9.5	323

Table 6 - Business Skills, Less Desired

Conclusions

The data appear to indicate that the four most critical skills for IT professionals are the ability to deal with the customer, investigate problems, show initiative, and organize activities to accomplish the goals of the organization. Based on this data, academic institutions should incorporate lectures, case discussions, and projects that

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assist in and encourage development of these skills. It is critical for students to understand a customer's perspective before they can adequately address the needs of that customer. Students should be taught how to generate, and subsequently be rewarded for, innovative ideas. Whenever possible, classroom discussions and projects should ensure students have to play "detective," asking probing questions and searching for clues to solve problems. Lastly, academia must teach students to manage time and project components in a professional manner.

Too often, technical courses focus on technical content that is, unquestionably, important. However, the data indicate that these four skills are as important to industry as are the vast majority of the highly desirable technical skills for each job cluster. It is imperative that these skills not be overlooked in the classroom.

PART FIVE: TECHNICAL KNOWLEDGE, SKILLS, AND ABILITIES

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PART FIVE:
TECHNICAL KNOWLEDGE,
SKILLS, AND ABILITIES

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Computer Programmer

Introduction

Computer programming is central to many important activities in information technology companies, such as developing new software packages to solve business problems, maintaining legacy code in existing software packages, and maintaining computer operating systems, such as Windows 98 or Linux, with which humans interact when using computers. Specifically, Computer Programmers write, test, and maintain programs that computers must follow to perform their functions. Applications programmers, both mainframe and client/server, write software to do jobs within an organization. Systems programmers maintain and control computer systems software.

Findings

Approximately 227 people participated in the computer programming section of the survey. The number of respondents to an individual item ranged from 220 to 227. As shown in the tables below, there were 53 items that were considered important for a Computer Programmer to know upon beginning this position.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

The first table shows that 16 items have a median of 0 or 1 (Extremely High or Very High) and an Importance Average of greater than 75. These items are considered "Highly Desired Characteristics." Pie charts of the top four items can be seen in Figures 12 through 15 in Appendix II. The six "highly desired" characteristics are directly related to writing programs: writing new code, modifying existing code, debugging code, knowledge of structured programming fundamentals, implementing programs, and a knowledge of programming languages. The next nine items, however, are not all specifically about computer programming. These items include reading design specifications and technical documentation, writing clear documentation for programs, and researching language syntax. The ability to design software, specifically user-friendly software, is highly desirable, as is knowledge of design specifications. The ability to estimate project time is a highly desirable characteristic of Computer Programmers. This could be because it takes much longer to produce robust code that works in all possible cases than to produce code that works in a few specific, expected cases. Software is also very easy to modify, relative to hardware, and so a programmer often will want to improve a program and may optimistically estimate that the incremental improvement will only take a short time to implement. The last item that is a "highly desired" characteristic is knowledge of client/server. Many of our interviewees expressed the opinion that client/server was an area of large growth, relative to mainframe, and that the growth rate would be increasing over the next several years.

COMPUTER PROGRAMMER									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Ability to Code Programs	146	73	6	2	0	0	109.5	227
2	Ability to Read, Understand and Modify Programs Written by Others	154	64	6	1	0	0	109.0	225
3	Ability to Debug Software	155	61	8	0	0	0	108.0	224
4	Knowledge of Structured Programming Fundamentals	115	88	20	3	0	0	101.5	226
5	Ability to Implement Programs	93	109	24	1	0	1	101.0	227
6	Knowledge of Programming Languages	96	105	24	1	0	1	100.5	226
7	Ability to Read Design Specifications for Conversion Into Code	99	90	36	1	0	1	94.5	226
8	Ability to Read Technical Documentation	65	120	36	5	1	1	92.5	227
9	Ability to Design Software Programs	87	94	36	6	2	1	90.5	225
10	Ability to Write Clear Documentation	72	107	43	5	0	1	89.5	227
11	Knowledge of Design Methodologies	52	123	50	2	0	1	87.5	227
12	Ability to Design User Friendly Applications	66	107	47	5	2	1	86.5	227
13	Ability to Research Language Syntax	81	85	39	12	4	1	83.0	221
14	Knowledge of Design Specifications	48	111	64	4	0	1	79.5	227
15	Ability to Estimate Project Time	47	111	55	13	0	1	79.0	226
16	Knowledge of Client/Server	64	90	60	12	0	1	77.0	226

Table 7 - Computer Programmer, Highly Desired

The set of items in the second table can be described as "Desired Characteristics." These are the 18 items that may be described as important, but not as important as the top sixteen. These all have medians of 1, but also have Importance Averages of greater than 52 but less than 75. The first three "Desired Characteristics," ranking 17th-19th overall, are the ability to work with multi-language programming projects, knowledge of software development tools, and knowledge of operating systems. Knowledge of any specific operating system is not as highly preferred, with Windows 95/98 and Windows NT ranking 25th and 27th, respectively. Although knowledge of programming languages is a "Highly Desired Characteristic," knowledge of any specific language was not as highly preferred. Knowledge of SQL ranks 20th, while knowledge of C and C++ ranks 26th and 28th, respectively. Knowledge of object-oriented concepts ranks 21st, knowledge of GUI design ranks 22nd, and the ability to write programs including APIs and DLLs ranks 23rd. Rounding out the list are knowledge of database management systems (24th) and database normalization (32nd), ability to install software (29th), knowledge of project management (30th), and ability to derive project plans (33rd), knowledge of technological trends (31st), and ability to flow chart (34th).

COMPUTER PROGRAMMER									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
17	Ability to Work With Multi-Language Programming Projects	52	94	67	12	1	1.	73.0	226
18	Knowledge of Software Development Tools	45	97	74	10	0	1	71.0	226
19	Knowledge of Operating Systems	36	105	79	6	1	1	70.5	227
20	Knowledge of SQL	60	81	71	11	2	1	70.5	225
21	Knowledge of Object Oriented Concepts	46	94	73	11	1	1	70.0	225
22	Knowledge of GUI Design	32	101	72	15	3	1	66.5	223
23	Ability to Write Programs including API's and DLL's	60	73	69	17	5	1	66.5	224
24	Knowledge of Database Management Systems	29	99	80	16	2	1	64.0	226
25	Knowledge of Windows 95/98/?	28	97	87	12	2	1	62.5	226
26	Knowledge of C	44	78	69	26	7	1	61.0	224
27	Knowledge of Windows NT	39	83	81	18	4	1	61.0	225
28	Knowledge of C++	41	80	81	19	4	1	60.5	225
29	Ability to Install Software	41	78	84	21	3	1	59.5	227
30	Knowledge of Project Management	32	85	93	11	3	1	58.5	224
31	Knowledge of Technological Trends	20	95	87	19	3	1	57.5	224
32	Knowledge of Database Normalization	18	96	89	18	4	1	57.0	225
33	Ability to Derive Project Plans	24	86	94	22	0	2	55.0	226
34	Ability to Flow Chart	36	73	71	37	8	2	54.5	225

Table 8 - Computer Programmer, Desired

The last table shows the items that can be said to be "Less Desired Characteristics." These are the nineteen items that rank the lowest for Computer Programmers. Most of these items have medians of 2 (Somewhat Important), but the last three have medians of 3 (Not Very Important). Their Importance Averages are less than

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52. General characteristics in this category included knowledge of customer industry (36th), and knowledge of network fundamentals (38th). But the items in this category consist primarily of the knowledge of specific technologies, such as database knowledge (Sybase-35th, Oracle-39th, Informix-43rd, Access-45th), operating systems knowledge (UNIX-37th, MacOS-51st), programming language knowledge (Visual Basic-40th, HTML-41st, JCL-42nd, Cobol-44th, Java-46th, and RPG-53rd), and knowledge of Novell NetWare (52nd). The remaining characteristics include knowledge of ergonomic interfaces (47th), ability to use CASE tools (48th), knowledge of web authoring tools (49th), and ability to troubleshoot hardware (50th).

COMPUTER PROGRAMMER									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
35	Knowledge of Sybase	23	80	78	42	0	2	51.5	223
36	Knowledge of Customer Industry	30	71	95	27	1	2	50.5	224
37	Knowledge of UNIX	30	68	82	36	8	2	49.0	224
38	Knowledge of Network Fundamentals	17	77	101	26	3	2	47.0	224
39	Knowledge of Oracle	30	60	81	36	16	2	45.0	223
40	Knowledge of Visual Basic	25	63	101	22	10	2	44.0	221
41	Knowledge of HTML	13	71	101	25	12	2	42.0	222
42	Knowledge of JCL	27	53	84	39	21	2	40.0	224
43	Knowledge of Informix	13	65	103	42	0	2	39.0	223
44	Knowledge of COBOL	22	41	75	53	34	2	31.5	225
45	Knowledge of Access	11	51	103	46	13	2	31.0	224
46	Knowledge of Java	10	50	116	34	11	2	30.0	221
47	Knowledge of Ergonomic Interfaces	5	49	108	50	8	2	27.0	220
48	Ability to use Computer Aided Software Engineering Software	10	40	93	64	16	2	25.0	223
49	Knowledge of Web Authoring Tools	7	37	122	43	15	2	22.0	224
50	Ability to Troubleshoot Hardware	9	34	116	52	15	2	21.5	226
51	Knowledge of MAC OS	2	26	84	109	0	2	14.0	221
52	Knowledge of Novell NetWare	2	18	88	75	41	3	10.0	224
53	Knowledge of RPG	6	10	39	86	81	3	8.0	222

Table 9 - Computer Programmer, Less Desired

Conclusions

Overall, it appears that the most desired characteristics for Computer Programmers are general abilities in designing, coding, modifying, and debugging programs, reading software design specifications and technical documentation, and writing clear documentation of programs. Client/server knowledge and GUI design capabilities are also important. There appears to be a lack of agreement about the importance of knowledge of any specific programming language, operating system, or database system. However, students must use specific languages and systems to learn how to code. SQL, C, and C++ ranked the highest out of all the languages, Windows

95/98/NT and UNIX ranked the highest out of all the operating systems, and Sybase and Oracle ranked the highest out of all the database systems. During the interviews, the view was expressed that students who had learned two programming languages probably had the ability to learn additional languages in the future, as necessary. Project management skills, including time estimation and planning, are also important. Finally, although not included in this part of the survey, interviews made it clear that "highly desired" characteristics of Computer Programmers also included the ability to think logically and critically, the ability to solve problems, the ability to work in teams, and the ability to think of technology as one tool out of many available for solving the business problems of customers.

SYSTEMS/BUSINESS ANALYST

Introduction

One of the most fundamental and challenging information technology positions is that of the systems analyst, also referred to as a business analyst, depending on the preferences of organization in question. These analysts are responsible for analyzing business needs through careful study of business processes and communication with customers. Once the analysis is completed, the analyst must communicate the results to the programmers who will code and implement the solution. The business analyst continues to act as liaison between the programmers and customers throughout the entire development and installation process.

The business analyst is key to ensuring a good fit between the information system and the organization. Their role is integral to the success of the information system and, in turn, the success of the organization.

Findings

Approximately 124 people participated in the computer engineer section of the survey. The number of respondents to an individual item ranged from 122 to 125. As shown in the tables below, there were thirty-two characteristics that were considered important for a business analyst.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

As reflected in the table above, there are five characteristics with a median value of less than 1 (Extremely High) and an Importance Average of greater than 58. Pie charts of the top four items can be seen in Figures 16 through 19 in Appendix II. Eight more have a median value of 1 (Very High) with an Importance Average of less than 57 and greater than 52. The top four characteristics all involve communicating with the customer to determine their needs. Two other characteristics involving customer relations rank sixth and eighth, respectively. These six skills represent all of the customer interface characteristics identified in the interviews and focus groups. This points to the importance of the non-technical communication component of the analyst's job function. The remaining seven skills all relate to knowledge of the business processes and needs. Six of these skills involve knowledge of the inputs, outputs, and processes required by the information system. The seventh involves knowing how to prioritize project needs so that the most critical components are ready first.

SYSTEMS BUSINESS ANALYST									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Ability to Ask Probing Questions to Determine Customer Needs	74	46	3	1	0	0.0	60.0	124
2	Ability to Maintain Open Communication with Customers	78	42	4	0	0	0.0	60.0	124
3	Ability to Determine Customer Needs	85	34	5	0	0	0.0	59.5	124
4	Ability to Communicate with Customers	83	36	4	0	0	0.0	59.5	123
5	Ability to Analyze Business Process	62	55	7	0	0	0.5	58.5	124
6	Ability to be Diplomatic	54	59	11	0	0	1.0	56.5	124
7	Ability to Prioritize Project Needs	51	59	13	1	0	1.0	55.0	124
8	Ability to Act as Liaison Between Customers and Programmers	60	48	13	3	0	1.0	54.0	124
9	Ability to Anticipate Future Needs	36	71	15	2	0	1.0	53.5	124
10	Ability to Conduct Needs Assessment	52	54	18	0	0	1.0	53.0	124
11	Ability to Analyze Systems Inputs and Outputs	46	60	15	2	0	1.0	53.0	123

Table 10 - Systems/Business Analyst, Highly Desired

The next set of characteristics can be described as "Desired Characteristics." These eight skills are viewed as important, although fewer respondents viewed them as important as the first set. These all have medians of 1 (Very High) and an Importance Average from 44 to 50.5.

With the exception of the knowledge of data flows, this group of skills can be categorized as those needed for successful management and implementation of a project. It should be noted that "data flows" which, from a technological standpoint, fits better with "knowledge of system processes," is rated immediately after system processes, although the importance break occurs between them.

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SYSTEMS BUSINESS ANALYST									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
12	Knowledge of Basic Business Concepts	50	55	18	2	0	1	52.5	125
13	Knowledge of System Processes	38	67	16	1	0	1	52.5	122
14	Knowledge of Data Flows	41	60	19	2	0	1	50.5	122
15	Knowledge of Project Management Principles	42	58	23	1	0	1	50.0	124
16	Knowledge of Business/Technology Integration	33	66	22	1	0	1	49.5	122
17	101) Knowledge of Business Processes	31	64	26	3	0	1	47.5	124
18	Ability to Control Project	38	55	27	3	1	1	46.5	124
19	Ability to Write a Functional Business/System Analysis	30	61	30	3	0	1	45.5	124
20	Ability to Implement Project Management Methodology	40	49	33	2	0	1	44.5	124
21	Ability to Define Project Management Critical Paths	36	52	34	1	0	1	44.0	123

Table 11 - Systems/Business Analyst, Desired

The last set of characteristics can be said to be "Less Desired." These eleven characteristics rank the lowest. Five of the eleven have medians of 1 and an Importance Average of 34.5 to 39.5. The remaining six have medians of 2 and an Importance Average of 12 to 29, respectively. The lowest scores are given to basic business skills. This, perhaps, underscores the importance of recognizing that the customer is the expert at what they need, and as long as the analyst can communicate with the user about those needs, the analyst does not need to be proficient at the business skills possessed by the user.

SYSTEMS BUSINESS ANALYST									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
22	Knowledge of Customer Industry	34	45	40	5	0	1	39.5	124
23	Knowledge of Database Design and Utilization	25	52	38	6	2	1	38.5	123
24	Ability to Manage a Meeting of Ten Users	22	51	44	7	0	1	36.5	124
25	Knowledge of Hardware/Software/OS Interactions	15	57	40	11	0	1	36.0	123
26	Knowledge of Distributed Computer Environments	15	54	39	13	1	1	34.5	122
27	Knowledge of Departmental Interdependency	17	41	57	9	0	2	29.0	124
28	Knowledge of Business Management	10	47	58	9	0	2	28.5	124
29	Knowledge of Business Administration	11	45	57	10	0	2	28.0	123
30	Knowledge of E-Commerce	11	33	59	17	2	2	22.0	122
31	Knowledge of Accounting	10	32	63	17	2	2	21.0	124
32	Knowledge of Corporate Finance	3	21	71	27	2	2	12.0	124

Table 12 - Systems/Business Analyst, Less Desired

Conclusions

Overall, the data indicates that the most important skill for an analyst is customer interaction. Of the top skills, five of the top six involves customer interaction. Furthermore, all of the skills involving customer interaction were ranked in the top eight skills listed. The second most important category of skills for the business analyst involve

needs assessment and prioritization issues. The combination of these two categories magnifies the importance of the business analyst's liaison role between the technical and non-technical aspects of the organization. The data clearly indicates that the two most important skills that should be addressed in the curriculum are interpersonal skills between the analyst and customer and the ability to analyze and anticipate the information system needs of the organization.

Computer Engineer

Introduction

Computer engineers design and develop new hardware and software. As software engineers, they develop software systems for control and automation in manufacturing, business, and other areas. While computer engineers sometimes focus on just hardware or just software, computer engineers frequently work on the integration of hardware and software.

Findings

Approximately eighty people participated in the computer engineer section of the survey. The number of respondents to an individual item ranged from 77 to 84. As shown in the table below, forty-seven items were identified as knowledge and abilities needed by entry-level computer engineers.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

The first table shows 19 items with a median value of 1 (Very High) and an Importance Average of greater than 26. These items are considered "Highly Desired Characteristics." The most desired characteristic is the ability to design solutions to meet specifications. This result is reasonable, given the computer engineer's broad role in designing and implementing overall solutions. In the remainder of the first table, there is a general preference for software over hardware, with the interaction of the two being of

intermediate importance. It is likely that this preference is indicative of the predominance of local companies with a software emphasis. The last item in the first table (ability to give effective directions to programmers) is noteworthy, because as it is indicative of the needs for interpersonal and management skills. It, along with an ability to create technical documentation, is the only non-technical items in table of "Highly Desired Characteristics." Pie charts of the top four items can be seen in Figures 20 through 23 in Appendix II.

COMPUTER ENGINEER									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Ability to Design Solutions to Meet Specifications	32	41	4	2	0	1	36.5	79
2	Knowledge of Programming Languages	39	33	10	1	0	1	36.0	83
3	Ability to Debug Software	34	35	6	2	1	1	34.5	78
4	Ability to Program	34	33	10	1	2	1	33.5	80
5	Knowledge of How Coding Affects Computer Systems Performance	33	32	14	1	0	1	32.5	80
6	Ability to Design	29	36	11	1	1	1	32.5	78
7	Knowledge of Operating Systems	24	40	15	1	0	1	32.0	80
8	Knowledge of Hardware/Software/OS Integration	21	39	14	6	0	1	30.0	80
9	Ability to Discern Effective Hardware/Software/OS Trade-off	17	41	17	4	0	1	29.0	79
10	Ability to Research Technology	20	37	17	5	0	1	28.5	79
11	Knowledge of Most Effective Coding Styles	22	34	20	4	1	1	28.0	81
12	Knowledge of Software/hardware Interfaces	18	37	21	4	0	1	27.5	80
13	Ability to Test Integrated Hardware/Software Solutions	17	38	19	3	2	1	27.5	79
14	Knowledge of Data Communication Fundamentals	12	43	23	2	0	1	27.5	80
15	Knowledge of Computer Engineering Foundations	19	35	22	4	0	1	27.0	80
16	Knowledge of Techniques used in Systems Engineering	16	38	21	3	0	1	27.0	78
17	Ability to Create Technical Documentation	13	41	20	4	0	1	27.0	78
18	Knowledge of Computer Hardware	19	34	27	0	0	1	26.5	80
19	Ability to Give Effective Directions to Programmers	18	35	20	4	0	1	26.5	77

Table 13 - Computer Engineer, Highly Desired

One more note before going to the second table: the choice of ranking by the Importance Average can be replaced by calculating weighted averages of the items in each category (Extremely Important through Not Important At All). With a few exceptions, this causes little change in the rank of the items. Three items move up: knowledge of computer hardware moves from 18th to 10th, ability to give effective directions to programmers moves from 19th to 13th, and knowledge of networking moves from 23rd to 17th. This change would move networking into the Highly Desired category. Three items also make significant moves downward: ability to test integrated hardware/software solutions moves from 13th to 18th, knowledge of data communication fundamentals moves from 14th to 19th, and ability to evaluate strengths/weaknesses of

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operating systems moves from 22nd to 27th. That these changes occur may be due to the relatively smaller sample size. In the computer programmer job cluster with its large sample size, the same analysis moves only one item (knowledge of COBOL) more than a little (from 44th to 49th).

The set of items in the second table can be described as "Desired Characteristics." These 11 items also have a median value of 1 with an Importance Average of 21.5 through 26. The items in the second table are a broader mix of characteristics. Generally, they consist of either areas of broad knowledge, which are of less importance, or of more specific knowledge such as C programming. Furthermore, items related to project management appear at this level of importance. While these items are categorized as less important than the "Highly Desired" category, they are still significant to the computer engineer.

COMPUTER ENGINEER									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
20	Ability to Manage Projects	17	35	26	6	0	1	26.0	84
21	Ability to Integrate Hardware/Software	17	35	22	4	1	1	26.0	79
22	Ability to Evaluate Strengths/Weaknesses of Operation Systems	12	39	22	5	1	1	25.5	79
23	Knowledge of Networking	18	32	29	1	0	1	25.0	80
24	Knowledge of C	25	24	19	8	3	1	24.5	79
25	Knowledge of C++	22	27	19	7	3	1	24.5	78
26	Ability to Test/Repair	19	28	24	5	2	1	23.5	78
27	Knowledge of Computer System Performance Evaluation	15	32	29	3	1	1	23.5	80
28	Ability to Use Project Management Tools Effectively	13	34	26	6	0	1	23.5	79
29	Knowledge of Real Time Systems	10	36	26	7	1	1	23.0	80
30	Ability to Flow Chart	14	29	22	9	4	1	21.5	78

Table 14 - Computer Engineer, Desired

The set of items in the last table can be described as "Less Desired Characteristics." These 17 items have a median value of 2 with an Importance Average of 4.5 through 19. The items in the last table are an even broader mix of characteristics than the items in the second table.

In examining the last table, knowledge of cost/benefits stands at the head of this category. The importance of an item is likely to depend on the particular segment of industry in which the computer engineer works. For example, someone applying computers in a manufacturing environment would find knowledge of automation control technology, such as programmable logic controllers, to be extremely important. The last two items are significantly lower than the other items. Most respondents likely consider the ability to repair hardware as more characteristic of a technician than an engineer. Furthermore, while the computer engineer may use specialized computer design tools, general use of CAD is unlikely.

COMPUTER ENGINEER									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
31	Knowledge of Cost/Benefits	3	35	33	6	3	2	19.0	80
32	Knowledge of Cross Platform Capabilities	11	25	41	3	0	2	18.0	80
33	Ability to Troubleshoot hardware	13	22	27	13	3	2	17.5	78
34	Knowledge of Assembly Language	19	14	30	15	5	2	16.5	83
35	Knowledge of Automation Control Technology	4	27	35	12	3	2	15.5	81
36	Knowledge of Communication Protocols in Detail	9	21	36	13	1	2	15.0	80
37	Ability to use Computer Aided Software Engineering Software	6	24	33	14	1	2	15.0	78
38	Ability to Code in Assembly Language	13	15	27	15	9	2	14.0	79
39	Ability to Write Device Drivers	10	15	25	22	7	2	12.5	79
40	Knowledge of Electronics Fundamentals	9	16	37	15	3	2	12.5	80
41	Knowledge of Control Systems	9	16	33	16	4	2	12.5	78
42	Knowledge of Industrial Processes	7	18	28	21	5	2	12.5	79
43	Knowledge of Voice Communication Fundamentals	5	19	39	15	2	2	12.0	80
44	Knowledge of Programmable Logic Devices	6	15	40	17	2	2	10.5	80
45	Knowledge of Hardware Description Languages	5	16	35	19	4	2	10.5	79
46	Ability to Repair Hardware	5	7	33	24	#	2	6.0	79
47	Ability to Use CAD	3	6	33	28	9	2	4.5	79

Table 15 - Computer Engineer, Less Desired

Conclusions

Overall, it appears that the most desired characteristic for the computer engineer is an ability to do design. This ability to design implies excellent critical thinking and problem-solving abilities. A strong background in computer fundamentals must support the ability to design with an especially strong emphasis on software. Based on the interviews with industry, as well as this survey, computer engineers are expected to have the necessary interpersonal/leadership skills and management knowledge to be able to lead project teams.

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Database Administrator

Introduction

Sixteen knowledge, skills, and abilities (KSAs) were identified as being at least somewhat important for the job of Database Administrator. Subject matter experts (SMEs) surveyed indicated a desire that newly hired employees have a working knowledge of database management systems, SQL, database optimization, database normalization, Oracle, Multiple DBMS, and data mining. In terms of abilities, SMEs expressed a desire that new hires be able to build tables and indexes, design databases to meet specifications, trouble shoot, optimize performance, manage databases, import/export data, manage data conversions, generate custom reports, and manage cross platform databases.

Findings

Approximately 98 people participated in the database administrator section of the survey. The number of respondents to an individual item ranged from 94 to 103. As shown in the table below, 20 items were identified as knowledge, skills, and abilities needed by entry-level database administrator.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

As shown in the table, there were six KSAs with a median value of 0 and an Importance Average of greater than 42. The two most desired characteristics are rather broad, a general knowledge of database management systems and the ability to build tables and indexes. Respondents indicated that specific knowledge of SQL was highly desirable. The final three KSAs categorized as "highly desired" seem to refer to the

ability to make optimal use of database technology features and to use the technology to solve problems unique to the employing organization. Pie charts of the top four items can be seen in Figures 24 through 27 in Appendix II.

DATABASE ADMINISTRATOR									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Knowledge of Database Management Systems	66	30	7	0	0	0	48.0	103
2	Ability to Build Tables and Indexes	57	32	9	0	0	0	44.5	98
3	Knowledge of SQL	63	25	9	1	0	0	44.0	98
4	Ability to Design Databases to Meet Specifications	56	32	7	1	0	0	44.0	96
5	Ability to Trouble Shoot	54	34	8	0	0	0	44.0	96
6	Knowledge of Database Optimization	53	32	11	0	0	0	42.5	96

Table 16 - Database Administrator, Highly Desired

Ten KSAs are categorized as "Desired Characteristics." A high percentage of respondents rate these items as either extremely important or very important. All of these KSAs have a median of 1 and an Importance Average of 31 to 42.5. This category includes knowledge of specific database software and operations, such as Oracle and Multiple DBMS, database normalization, and data mining. Also included are abilities related to specific database operations, such as ability to optimize performance, ability to import/export data, ability to manage data conversions, ability to generate custom reports, and ability to manage cross platform databases.

DATABASE ADMINISTRATOR									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
7	Ability to Optimize Performance	47	38	12	1	0	1	42.5	98
8	Knowledge of Database Normalization	45	39	12	0	0	1	42.0	96
9	Ability to Manage Database	46	37	14	1	0	1	41.5	98
10	Ability to Import/Export Data	44	35	15	2	1	1	39.5	97
11	Ability to Manage Data Conversions	36	39	21	2	0	1	37.5	98
12	Knowledge of Oracle	36	29	26	7	1	1	32.5	99
13	Ability to Generate Custom Reports	25	40	29	3	1	1	32.5	98
14	Knowledge of Multiple DBMS	22	42	30	3	0	1	32.0	97
15	Knowledge of Data Mining	17	47	28	5	0	1	32.0	97
16	Ability to Manage Cross Platform Databases	19	43	31	3	0	1	31.0	96

Table 17 - Database Administrator, Desired

Finally, four KSAs are categorized as "Less Desired," but still somewhat important. These items have a median of 2 and an Importance Average of less than 22. This category includes knowledge of three rather specific database packages: Access, Sybase, and Informix. Also included is the ability to perform cost/benefit analysis.

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DATABASE ADMINISTRATOR									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
17	Knowledge of Access	10	32	41	14	0	2	21.0	97
18	Ability to Perform Cost/Benefit Analysis	6	29	51	11	0	2	17.5	97
19	Knowledge of Sybase	4	18	49	23	4	2	11.0	98
20	Knowledge of Informix	4	15	43	26	6	2	9.5	94

Table 18 - Database Administrator, Less Desired

Conclusions

Overall, it appears that the most desired characteristics for the database administrator are an ability to do design databases and an understanding of the fundamental principles of databases. There appears to be less concern with knowing any particular database system, even though many respondents expressed interest in Oracle.

Computer Support Specialist

Introduction

A computer support specialist provides technical assistance, support, and advice to clients and users, such as software services consulting. This individual becomes the customer's "lifeline" when it comes to problem solving directed at the customer's individual needs. It is the Computer Support Specialist who is constantly monitoring the customer's account to insure that potential problems are avoided and problems, which do arise, are quickly remedied. The Computer Support Specialist must have an understanding of the customer's business and its relationship to information technology being used. In addition, the Specialist must be able to develop a trusting relationship with the customer on a long-term basis.

Findings

Approximately 65 people participated in the computer support specialist section of the survey. The number of respondents to an individual item ranged from 62 to 66. As shown in the table below, 22 items were identified as knowledge and abilities needed by entry-level computer support specialists.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

The first table shows six items with a median value of 0 and an Importance Average of greater than 30. These items are considered "Highly Desired Characteristics." As an example, of the top seven responses, four of the seven related directly to abilities, such as the ability to exercise patience, to listen emphatically, to exercise general interpersonal skills and the ability to calm the customer. The other abilities are directly related to problem-solving techniques and the ability to discuss issues with the customer

in lay terms. Pie charts of the top four items can be seen in Figures 28 through 31 in Appendix II.

COMPUTER SUPPORT SPECIALIST									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Ability to Visualize User Problems	40	25	1	0	0	0	32.5	66
2	Ability to Walk the User Through a Solution in Layman's Terms	32	32	2	0	0	0	32.0	66
3	Ability to Solve Problems	40	23	1	0	0	0	31.5	64
4	Ability to Exercise Patience	33	30	3	0	0	0	31.5	66
5	Ability to Listen Empathetically	34	28	3	1	0	0	31.0	66
6	Ability to Exercise Interpersonal Skills	36	25	5	0	0	0	30.5	66

Table 19 - Computer Support Specialist, Highly Desired

As the Committee move down the scale and look to the knowledge and abilities that appeared to be the middle of the list, the Committee found more knowledge and abilities that relate directly to an information technology background. These next nine (9) responses direct the student(s) to develop more specific abilities in such areas as the ability to improvise solutions, the ability to differentiate user error/hardware/software problems, the ability to relate to diverse audiences, the ability to think fast in stressful situations and so on. In looking at the knowledge necessary at this level, the participants think the most important things to know concern business communications, customer software, the impact of technology on business, and knowledge of the customer's business. All of the items in this category have a median value of 1 and an Importance Average from 24 to 30.

COMPUTER SUPPORT SPECIALIST									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
7	Ability to Calm the End User	26	34	5	1	0	1	30.0	66
8	Ability to Improvise Solutions	23	37	4	1	0	1	30.0	65
9	Ability to Differentiate User Error/Hardware/Software Problems	34	25	7	0	0	1	29.5	66
10	Ability to Relate to Diverse Audiences	28	31	6	1	0	1	29.5	66
11	Ability to Think Fast in a Stressful Situation	28	30	8	0	0	1	29.0	66
12	Knowledge of Business Communication	24	29	13	0	0	1	26.5	66
13	Knowledge of Customer Software	21	31	13	0	0	1	26.0	65
14	Ability to Document Help Tasks	8	43	14	1	0	1	25.5	66
15	Knowledge of the Impact of Technology on Business	20	29	13	4	0	1	24.5	66
16	Knowledge of Customer's Industry	17	31	16	1	0	1	24.0	65

Table 20 - Computer Support Specialist, Desired

Moving down to those abilities and knowledge that are thought to be of lesser importance, the Committee find such knowledge areas as knowledge of computer hardware, knowledge of presentation software, and lastly, knowledge of computer

programming. The least desirable abilities are the ability to use Web search engines, the ability to configure a PC, and the ability to use presentation software. In the last category, half of the items have a median of 1, and half have a median of 2. The Importance Average is less than 23, with knowledge of programming being extremely low at 7.5.

COMPUTER SUPPORT SPECIALIST									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
17	Knowledge of Computer Hardware	18	27	17	3	0	1	22.5	65
18	Ability to Use Web Search Engines	14	24	21	7	0	1	19.0	66
19	Knowledge of Presentation Software	14	21	23	7	0	1	17.5	65
20	Ability to Configure a PC	12	17	26	9	1	2	14.5	65
21	Ability to Use Presentation Software	9	16	28	12	1	2	12.5	66
22	Knowledge of Programming	2	13	33	14	3	2	7.5	65

Table 21 - Computer Support Specialist, Less Desired

Conclusions

From the data obtained, the computer support specialist must be able to sit down with the customer, listen with an open mind, ask probing questions, empathize with the customer's problems, and gain the customer's trust that a speedy and appropriate solution can be found. The computer support specialist must have the ability to talk to the customer at his/her level, be able to work with a wide range of customer personalities, be able to exercise patience in what may sometimes be stressful encounters, and be able to de-fuse a tense situation when necessary; all this, while being able to gather the appropriate information to solve the customer's problem.

This job cluster requires a person with the ability to analyze a customer's needs and problems in relation to the customer's own business, and communicate appropriate solutions to the customer in terms that he/she can understand. Although this position may not require a great deal of high-level, hands-on computer technology knowledge, it does, in fact, require a broad understanding of information technology functions as it relates to the customer's business and to the products and/or services being provided the customer.

This position does require abilities that can be learned as well as knowledge and skills that may already be part of the potential employee's personality. In other words, the knowledge, skills, and abilities associated with a computer support specialist are a "blend" of all these things, both learned and inbred. Part of the task associated with educating an individual for this position will be to determine which of these are already in place and which need to be taught and or "polished." Because of the broad range of knowledge, skills, and abilities, this position should be one that is highly sought by information technology minors.

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NETWORK SPECIALIST

Introduction

The dramatic escalation in the number of microcomputer networks over the last decade and a half has led to the need for network specialists. Many organizations have turned to client/server platforms to either supplement or replace their mainframes. This section addresses the skill set needed by the individuals charged with designing, implementing, and supporting computer networks. Network specialists design, install, and support an organization's distributed computing (LAN, WAN, network segment, or Internet system). Network and data communications analysts design, test, and evaluate network systems and perform modeling, analysis, and planning.

Findings

Approximately 58 people participated in the network specialist section of the survey. The number of respondents to an individual item ranged from 56 to 59. As shown in the table below, twenty-eight items were identified as knowledge and abilities needed by entry-level network specialist.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included because not all respondents answered all questions.

Discussion

As reflected in the table below, there are three characteristics with a median value of 0 (Extremely High) and an Importance Average 28. Three more have a median value of 1 (Very High) and an Importance Average of 27 to 27.5. Pie charts of the top four items can be seen in Figures 32 through 35 in Appendix II. The highest ranked skills are the knowledge of network protocols, network hardware, and troubleshooting abilities. The next three include knowledge of communication fundamentals, connectivity methods, and security issues. Collectively, these six skills allow the specialist to

understand what is necessary for network communications to occur and how to locate problems when the communications either do not occur or occur incorrectly.

NETWORK SPECIALIST									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Knowledge of Network Protocols	35	21	3	0	0	0	28.0	59
2	Knowledge of Networking Hardware	30	26	3	0	0	0	28.0	59
3	Ability to Troubleshoot	30	26	2	0	0	0	28.0	58
4	Knowledge of Communication Fundamentals	25	30	3	0	0	1	27.5	58
5	Knowledge of Connectivity Methods	25	29	4	0	0	1	27.0	58
6	Knowledge of Network Security Issues	22	32	4	0	0	1	27.0	58

Table 22 - Network Specialist, Highly Desired

The next set of characteristics can be described as "Desired Characteristics." These thirteen skills are viewed as important, although fewer respondents view them as important as the first set. These all have medians of 1 (Very High) and an Importance Average from 20 to 25.5. These skills are all narrower in focus than those in the first set, indicating the necessity for broad understanding of networking fundamentals. This group of characteristics is more likely to be important to larger organizations than small organizations, while the first set is important regardless of size.

NETWORK SPECIALIST									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
7	Knowledge of Operating Systems	21	30	8	0	0	1	25.5	59
8	Ability to Manage/Schedule Time	16	33	8	0	0	1	24.5	57
9	Ability to Analyze Network Needs	22	26	10	0	0	1	24.0	58
10	Ability to Configure Network Components	24	24	9	0	0	1	24.0	57
11	Ability to Optimize Network Performance	21	27	10	0	0	1	24.0	58
12	Knowledge of Networking/Product Relationships	16	31	11	0	0	1	23.5	58
13	Ability to Monitor Networks	16	31	11	0	0	1	23.5	58
14	Knowledge of Basic Communication Debugging	21	24	12	1	0	1	22.5	58
15	Knowledge of Windows NT	23	21	14	1	0	1	22.0	59
16	Ability to Design LAN	17	26	12	2	0	1	21.5	57
17	Ability to Manage the Network	22	21	14	1	0	1	21.5	58
18	Ability to Use Test Equipment	15	26	15	1	1	1	20.5	58
19	Knowledge of Communication Media	10	30	17	1	0	1	20.0	58

Table 23 - Network Specialist, Desired

The last set of characteristics can be said to be "Less Desired." These nine characteristics are ranked the lowest on the list. However, all nine have medians of 1, which indicates that the importance of the skill is still "Very High," i.e. more individuals feel these skills were either "Extremely Important" or "Very Important" than not. In short, these items are ranked last based on an Importance Average from 16.5 to 19. Like the

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previous group, these skills are narrower in scope than the "Highly Desired Characteristics." It also should be noted that of all items, only knowledge of UNIX and ability to use test equipment received responses that indicated that they were "Not Important," and each received only one response in that category.

NETWORK SPECIALIST									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
20	Knowledge of Communication Software	12	26	19	1	0	1	19.0	58
21	Ability to Design WAN	10	28	18	2	0	1	19.0	58
22	Knowledge of Techniques of Systems Engineering	7	30	21	0	0	1	18.5	58
23	Ability to Design	10	27	17	2	0	1	18.5	56
24	Ability to Pass Network Certification	14	23	16	4	0	1	18.5	57
25	Knowledge of Novell NetWare	13	23	20	3	0	1	18.0	59
26	Ability to Flowchart/Diagram	8	28	21	1	0	1	18.0	58
27	Ability to Interact With Vendors	10	24	22	2	0	1	17.0	58
28	Knowledge of UNIX	9	24	23	2	1	1	16.5	59

Table 24 - Network Specialist, Less Desired

Conclusions

Overall, the data indicates that the most important skills for a network specialist are broad-based understanding of network components with network protocols ranked first and networking hardware and troubleshooting abilities in a virtual tie for second place. The data confirm opinions expressed during interviews and focus group sessions that organizations are willing, and often expect to, train network specialists on the technical details required by their organization, as long as the individual has the foundation necessary to understand those details.

Telecommunication Analyst

Introduction

Telecommunications analysts focus on the interaction between computer and communications equipment. They work with both the technology of the various aspects of the communication industry and the technology of the computer industry.

Findings

Approximately thirty-one people participated in the telecommunication section of the survey. The number of respondents to an individual item ranged from 29 to 34. As shown in the table below, twenty-two items were identified as knowledge and abilities needed by entry-level telecommunication analysts. This section had the smallest number of responses. This job cluster is also the area where the Committee had the fewest number of participants in the focus groups. As a result, the items in this section of the survey tend to be, for the most part, only of a broad, general nature. As will be seen in the discussion section, this situation leads too much less variation in the level of importance of the individual items.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

For the telecommunication job cluster, all the items have a median value of 1, with one exception; the first item in the table has a value of .5. The first table shows 7 items with an Importance Average of greater than 12. These items are considered "Highly Desired Characteristics." The most desired characteristic is knowledge of basics of communications. In the remainder of the first table, there is a mix of general topics and specific topics. Pie charts of the top four items can be seen in Figures 36 through 39 in Appendix II.

One more note before going to the second table: the choice of ranking by the Importance Average could be replaced by calculating weighted averages of the items in

each category - Extremely Important through Not Important At All. With a few exceptions, this causes little change of the rank of the items. Two items move up: knowledge of fundamentals of electronics moves from 11th to 5th, and ability to design cost-effective communication networks moves from 12th to 6th. This change would move knowledge of fundamentals of electrónics into the Highly Desired category. Three items also make significant moves downward: knowledge of signal analysis from 4th to 15th, knowledge of signal encoding moves from 7th to 16th, and ability to troubleshoot in a wide geographic area moves from 18th to 22nd. That these changes occur may be due to the relatively smaller sample size. In the computer programmer job cluster, with its large sample size, the same analysis moves only one item (knowledge of COBOL) more than a little (from 44th to 49th).

TELCOMMUNICATIONS ANALYST									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Knowledge of Basics of Communications	15	13	2	0	0	0.5	14.0	30
2	Knowledge of Telecommunications Protocol	14	14	4	0	0	1.0	14.0	32
3	Ability to Understand Telcom System Flow	7	18	6	0	0	1.0	12.5	31
4	Knowledge of Signal Analysis	5	20	6	3	0	1.0	12.5	34
5	Knowledge of Telecommunication Hardware	5	20	6	1	0	1.0	12.5	32
6	Knowledge of Computing Fundamentals	9	15	7	0	0	1.0	12	31
7	Knowledge of Signal Encoding	4	20	7	2	0	1.0	12	33

Table 25 - Telecommunication Analyst, Highly Desired

The set of items in the second table can be described as "Desired Characteristics." These 10 items also have a median value of 1 with an Importance Average of 9.5 through 11.5. The items in the second table are also a broader mix of characteristics.

TELCOMMUNICATIONS ANALYST									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
8	Knowledge of Telecommunications Software	5	18	9	0	0	1	11.5	32
9	Ability to Research New Technologies	5	18	7	0	0	1	11.5	30
10	Knowledge of Evolving Telecommunication Technologies	4	19	8	0	0	1	11.5	31
11	Knowledge of Fundamentals of Electronics	10	12	10	0	0	1	11.0	32
12	Ability to Design Cost Effective Communication Networks	7	15	9	0	0	1	11.0	31
13	Knowledge of Telco Operations and Networks	6	16	8	1	0	1	11.0	31
14	Ability to Interface OS and Communication Devices	5	17	9	0	0	1	11.0	31
15	Knowledge of Signal Noise Analysis and Bit Rate Errors	5	16	9	2	0	1	10.5	32
16	Ability to Deal with Telcos and Vendors	7	12	11	1	0	1	9.5	31
17	Ability to Design Communication Network Using a Variety of Technologies	6	13	12	0	0	1	9.5	31

Table 26 - Telecommunication Analyst, Desired

Generally, the items in the second table consist of either areas of broad knowledge, which are of less importance, or of more specific knowledge, such as the knowledge of signal noise analysis and bit rate errors. While these items have been categorized as less important than the "Highly Desired" category, they are still significant to the telecommunication analyst.

The set of items in the last table can be described as "Less Desired Characteristics." These 5 items have an Importance Average of 7.5 through 8.5.

TELCOMMUNICATIONS ANALYST									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
18	Ability to Troubleshoot in a Wide Geographic Area	4	13	11	2	1	1	8.5	31
19	Ability to Flow Chart and Diagram	4	13	14	0	0	1	8.5	31
20	Ability to Design/Layout Telecom Cabling Scheme	3	14	13	1	0	1	8.5	31
21	Ability to Design	3	13	15	0	0	1	8.0	31
22	Knowledge of Signaling Systems such as SS-7	5	10	13	1	0	1	7.5	29

Table 27 - Telecommunication Analyst, Less Desired

Conclusions

Overall, the limited range of items and the small sample size make the data from this portion of the survey of less use. Certainly, the telecommunication analyst is expected to have a solid background in communications. However it is harder to differentiate between the level of importance of the other item.

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Internet Specialist

Introduction

The Internet is one of the fastest growing, popular areas of computer and information technology. People, households, and businesses are increasingly utilizing the Internet for access to information and resources, and as a way to conduct business. This section of the report deals with those charged with making these connections and developing Internet solutions: Internet Specialists. Internet specialists are involved in the design, development, and maintenance of Web sites and servers. Typical jobs include Webmasters, who are responsible for all technical aspects of the web site, and Web Developers, who are responsible for site design and creation.

Findings

Approximately fifty-five people participated in the Internet specialist section of the survey. The range of respondents was from 46 to 55. As shown in the tables below, there were forty-one items that were considered important for an Internet Specialist to know upon beginning this position.

These knowledge, skill, and ability items have been divided into those considered "Highly Desired," "Desired," and "Less Desired." The items are listed in order of the aggregate preference indicated by all respondents to the web-based survey. The categories of responses are Extremely Important (EI), Very Important (VI), Somewhat Important (SI), Not Very Important (NVI), and Not Important (NI).

Also included in the tables are the medians of the responses for that item (0 = Extremely Important, 1 = Very Important, 2 = Somewhat Important, and 3 = Not Very Important). Because so many of the items were very close together in their median values, an additional measure

$$\frac{EI + VI}{2}$$

also was used. This allowed items to be arranged, within the median ranking, by the average of the numbers of Extremely Important and Very Important responses. This average will be referred to as the Importance Average. The number of respondents (N) was included, because not all respondents answered all questions.

Discussion

As shown in the first table, there are 14 characteristics with a median value of 0 or 1 (Extremely High or Very High) and an Importance Average greater than 22. These items are considered "Highly Desirable Characteristics." The two most desired characteristics are technical in nature: knowledge of HTML and knowledge of Internet browsers. This result is expected, given that Internet specialists will typically be the

people tasked to write Web pages and to make sure that they operate effectively on different browsers. Pie chart representations of these results can be seen in Figures 40 and 41 in Appendix II. The next five most desirable characteristics, however, are more customer-based than technically based. These are the ability to match web solutions to customer objectives, the ability to meet customer needs, the ability to meet customer design specifications, and the ability to communicate with the user to determine needs. Pie chart representations of the first two of these characteristics can be seen in Figures 42 and 43 in Appendix II. This points to the belief that Internet Specialists must have more than pure technical skills. They also must have interpersonal skills and the ability to match customer needs to technical developments. The rest of the most desirable characteristics are technical in nature. Each of these addresses the ability of the Internet Specialist to accomplish the tasks of developing, setting up, and administering Internet and Web sites.

INTERNET SPECIALIST									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Knowledge of HTML	41	13	1	0	0	0	27.0	55
2	Knowledge of Internet Browsers	30	22	3	0	0	0	26.0	55
3	Ability to Match Web Solutions to Customer Objectives	33	18	3	0	0	0	25.5	54
4	Ability to Meet Customer Needs	35	15	3	0	0	0	25.0	53
5	Ability to Meet Customer Design Specifications	29	21	4	0	0	0	25.0	54
6	Ability to Analyze and Troubleshoot	29	21	4	1	0	0	25.0	55
7	Ability to Communicate with User to Determine Needs	31	18	5	0	0	0	24.5	54
8	Ability to Design Esthetic and Functional Web Pages	24	24	6	0	0	1	24.0	54
9	Knowledge of Scripting Languages	20	28	7	0	0	1	24.0	55
10	Knowledge of Web Security	30	16	8	0	0	1	23.0	54
11	Knowledge of User Interface Design Principles	24	22	9	0	0	1	23.0	55
12	Ability to Write Efficient Code that Reduces Downtime	19	27	6	1	0	1	23.0	53
13	Ability to Design	17	29	6	1	0	1	23.0	53
14	Knowledge of Design Principles	15	30	10	0	0	1	22.5	55

Table 28 - Internet Specialist, Highly Desired

The next set of characteristics can be described as "Desired Characteristics." These are the seventeen characteristics that may be described as "important," but not as important as the top fourteen characteristics. These all have medians of 1, but Importance Averages of 18-21. All of the characteristics in this category are technical skills. Some of them are specific to the Internet, such as ability to link web pages and knowledge of DHTML, while others are more generic, such as knowledge of Windows NT and knowledge of databases.

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INTERNET SPECIALIST									
Rank	DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
15	Knowledge of How Web Applications are Affected by Bandwidth	23	20	11	0	0	1	21.5	54
16	Ability to Link Web Pages to Databases	23	20	9	1	0	1	21.5	53
17	Ability to Design Code for High Volume Circumstances	19	24	10	0	0	1	21.5	53
18	Knowledge of Basic Client Server Technology	15	27	13	0	0	1	21.0	55
19	Ability to Perform Field Validation on the Client	14	28	10	1	0	1	21.0	53
20	Knowledge of Windows NT	18	23	12	2	0	1	20.5	55
21	Ability to Write	13	28	13	0	0	1	20.5	54
22	Knowledge of Languages	12	28	12	3	0	1	20.0	55
23	Ability to Write Browser Independent Code	18	21	12	2	0	1	19.5	53
24	Knowledge of Operating Systems	14	25	14	1	0	1	19.5	54
25	Knowledge of DHTML	10	28	13	2	0	1	19.0	53
26	Knowledge of Markup Languages	21	15	10	0	0	1	18.0	46
27	Knowledge of Java	17	19	17	1	2	1	18.0	56
28	Knowledge of Networks	17	19	17	2	0	1	18.0	55
29	Knowledge of ASP, CGI, PERL	16	20	16	1	0	1	18.0	53
30	Knowledge of Cross Platform Usage	12	24	18	0	0	1	18.0	54
31	Knowledge of Databases	11	25	18	1	0	1	18.0	55

Table 29 - Internet Specialist, Desired

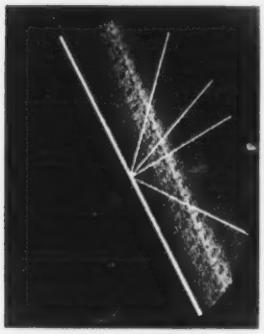
The last set of characteristics can be said to be "Less Desired." These are the ten characteristics that were ranked the lowest for the Internet Specialist. Some of these have medians of 1 (Very Important), and some have medians of 2 (Somewhat Important); but they all have Importance Averages of less than 18. Again, each of these skills are technical in nature and most are not directly related to functions of the Internet (i.e. Knowledge of C/C++, Knowledge of Windows 95/98, etc.).

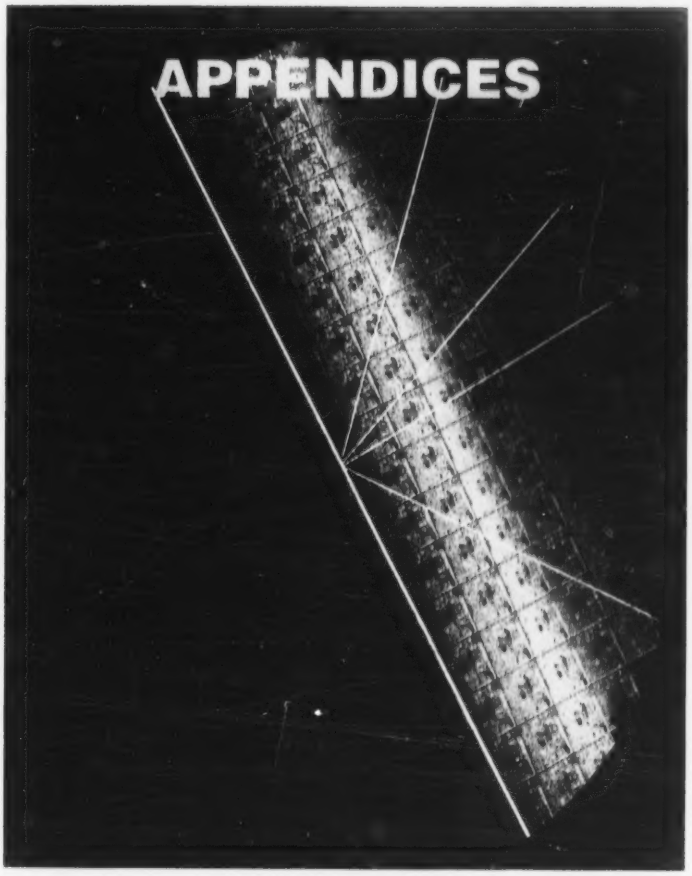
INTERNET SPECIALIST									
Rank	LESS DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
32	Knowledge of Web Monitoring Tools	14	21	19	1	0	1	17.5	55
33	Knowledge of Multimedia Design Technologies	13	22	18	0	0	1	17.5	53
34	Knowledge of Windows 95/98	14	20	19	0	0	1	17.0	53
35	Ability to Design Still and Motion Graphics	7	22	19	4	1	1	14.5	53
36	Knowledge of UNIX	10	18	20	5	1	1	14.0	54
37	Knowledge of XML	8	17	22	5	1	2	12.5	53
38	Ability to Code in Multiple Languages	8	17	23	4	1	2	12.5	53
39	Ability to Write Java Applets	6	19	21	4	2	2	12.5	52
40	Ability to Integrate Audio Technologies	4	16	25	5	3	2	10.0	53
41	Knowledge of C/C++	4	14	29	6	1	2	9.0	54

Table 30 - Internet Specialist, Less Desired

Conclusions

Overall, it appears that the most desired characteristics for Internet Specialists are the technical skills most relevant to the Internet and interpersonal skills that would allow an entry-level person in this position to be able to interact with customers. Potential course offerings to obtain these desired skills should include courses on the functions and operation of Web browsers and HTML coding. Equally important, however, are courses that teach interpersonal and communication skills and those that promote critical thinking and problem-solving skills in the student.





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Appendices

Appendix I – IT Survey

University of Arkansas at Little Rock
Information Technology Survey

Thank you for taking the time to participate in this survey.

The information collected here will be used to design curricula in Information Technology and Systems Engineering. In addition, the Committee hopes to develop a minor curriculum for non-technical majors. When you finish the survey, please go to the end and press the "SUBMIT SURVEY" button.

There will be four short sections to the survey:

1. Demographic Information
2. Non-Technical, Soft-Skills
3. Business Concepts
4. Knowledge, Skills, and Abilities in eight job clusters
   - Computer Programmers
   - Systems/Business Analysts
   - Computer Engineers
   - Database Administrators
   - Computer Support Specialist
   - Network Specialists
   - Telecommunications Analysts
   - Internet Specialists

CONFIDENTIALITY: Your participation in this survey is completely confidential. The purpose of the survey is to collect data to help us design appropriate Information Technology programs at UALR. Any results that are reported will contain data that is averaged over many participants. At no point will your individual responses be reported to the public or to your employer.

---

1) Name:

2) Highest level of education achieved:

High school	Master's degree
Post high school technical training	Doctoral degree
Associate degree (2 years of college)	
Bachelor's degree (4 years of college)	Other (Please specify):

3) What is your e-mail address?

4) If you completed your college degree, please indicate what your major (concentration of study) was.

5) Name of your company (organization):

6) Which of the following job clusters best describe your area?

Computer programmer	Computer support specialist
Systems/Business analyst	Network specialist
Computer engineer	Telecommunications analyst
Database administrator	Internet specialist

7) Job title (if applicable):

8) Number of years of employment at current company (organization):

9) Number of years of employment in the information technology field:

10) Please indicate the primary computer programming languages that you use regularly in your job.

C	Java	HTML
C++	RPG	
SQL	COBOL	Other (Please specify):

11) Please list the primary computer software packages that you use regularly in your job.

12) What primary operating systems are used by your company (check all that apply)?

Main frame	Win 95/98	Mac
UNIX	Win NT	Other (Please specify):

Please indicate how important each of these Non-technical, Soft-skills would be for an entry-level person in information technology.

13) Verbal Communication

Extremely Important
Very Important
Somewhat Important
Not Very Important
Not Important At All

[Editor's Note: For all of the following questions the respondents were asked to select one of the five categories as shown above. In the rest of the questions, these choices have not been shown.]

14) Technical writing

15) General writing skills

16) Time management

17) Visualize/conceptualize

18) Problem solving process (decision tree, problem identification, analysis, solving)

19) Team Work (long term)

20) Constructive criticism (delivery and receipt)

21) Interpersonal skills

22) Diversification (different cultures)

23) Stress management

24) Adaptability to new technology, new languages

25) Business culture (priorities, schedules, self-initiating)

26) Leadership (interactions with peers, servant leadership)

27) Transferring knowledge to application

28) Ability to multi-task

29) Organizational skills

30) Presentation skills

31) Inter-team communication

32) Listening

Please indicate how important each of these Business Skills would be for an entry level person in information technology.

33) Use of capital (risk and return)

34) Reading a budget (and understanding)

35) "Be the customer" mentality

36) Idea initiation

37) Interviewing skills

38) Investigative skills (probing questions)

39) Mediation skills

40) Reading a balance sheet and income and expense summary

41) Basic accounting

42) Role playing

43) Project Management

44) Marketing

In this section, you will be asked to rate the importance of Knowledge, Skills, and Abilities in eight IT job clusters where you have knowledge of entry level qualifying factors. If you do not know the job requirements for a cluster (i.e. those defined in blue text), just skip to another cluster.

Click on one of the job clusters below to begin.

Computer Programmers
Systems/Business Analysts
Computer Engineers
Database Administrators
Computer Support Specialist
Network Specialists
Telecommunications Analysts
Internet Specialists

[Editor's Note: The above menu was a set of hyperlinks that allow the respondent to go directly to the job cluster of interest.]

Computer Programmers write, test, and maintain programs that computers must follow to perform their functions. This cluster includes Applications programmers, both mainframe and client/server, who write software for jobs within an organization and Systems programmers who maintain and control computer systems software.

Please indicate how important each of these items is for an entry level Computer Programmer.

45) Knowledge of Object Oriented Concepts

46) Knowledge of GUI Design

47) Knowledge of Ergonomic Interfaces

48) Knowledge of Structured Programming Fundamentals

49) Knowledge of Design Methodologies

50) Knowledge of Design Specifications

51) Knowledge of Database Normalization

52) Knowledge of Programming Languages

53) Knowledge of C

54) Knowledge of C++

55) Knowledge of RPG

56) Knowledge of Java

57) Knowledge of COBOL

58) Knowledge of Visual Basic

59) Knowledge of HTML

60) Knowledge of JCL

61) Knowledge of Web Authoring Tools

62) Knowledge of Operating Systems

63) Knowledge of UNIX

64) Knowledge of Windows NT

65) Knowledge of Windows 95/98/?

66) Knowledge of Novell NetWare

67) Knowledge of MAC OS

68) Knowledge of Database Management Systems

69) Knowledge of SQL

70) Knowledge of Oracle

71) Knowledge of Sybase

72) Knowledge of Access

73) Knowledge of Informix

74) Knowledge of Project Management

75) Knowledge of Network Fundamentals

76) Knowledge of Technological Trends

77) Knowledge of Customer Industry

78) Knowledge of Client/Server

79) Knowledge of Software Development Tools

80) Ability to Design Software Programs

81) Ability to Flow Chart

82) Ability to Derive Project Plans

83) Ability to Design User Friendly Applications

84) Ability to Estimate Project Time

85) Ability to use Computer Aided Software Engineering Software

86) Ability to Code Programs

87) Ability to Debug Software

88) Ability to Write Programs including API's and DLL's

89) Ability to Research Language Syntax

90) Ability to Read, Understand and Modify Programs Written by Others

91) Ability to Work With Multi-Language Programming Projects

92) Ability to Read Design Specifications for Conversion Into Code

93) Ability to Implement Programs

94) Ability to Write Clear Documentation

95) Ability to Install Software

96) Ability to Troubleshoot Hardware

97) Ability to Read Technical Documentation

[Editor's Note: The above represents two hyperlinks that allowed the respondent to go to the job cluster menu and select another job cluster or to go to the end of the survey and submit the survey.]

Systems/Business Analysts study business, scientific, or engineering data processing and use computers to design solutions.

Please indicate how important each of these items is for an entry level Systems/Business Analyst.

98) Knowledge of Basic Business Concepts

99) Knowledge of Accounting

100) Knowledge of Business Administration

101) Knowledge of Business Processes

102) Knowledge of Corporate Finance

103) Knowledge of Business Management

104) Knowledge of E-Commerce

105) Knowledge of Departmental Interdependency

106) Knowledge of Customer Industry

107) Knowledge of Project Management Principles

108) Knowledge of Business/Technology Integration

109) Knowledge of Data Flows

110) Knowledge of System Processes

111) Knowledge of Hardware/Software/OS Interactions

112) Knowledge of Database Design and Utilization

113) Knowledge of Distributed Computer Environments

114) Ability to Determine Customer Needs

115) Ability to Analyze Business Process

116) Ability to Conduct Needs Assessment

117) Ability to Analyze Systems Inputs and Outputs

118) Ability to Ask Probing Questions to Determine Customer Needs

119) Ability to Anticipate Future Needs

120) Ability to Communicate with Customers

121) Ability to Maintain Open Communication with Customers

122) Ability to Manage a Meeting of Ten Users

123) Ability to be Diplomatic

124) Ability to Control Project

125) Ability to Implement Project Management Methodology

126) Ability to Define Project Management Critical Paths

127) Ability to Prioritize Project Needs

128) Ability to Write a Functional Business/System Analysis

129) Ability to Act as Liaison Between Customers and Programmers

Computer Engineers design and develop new hardware and software. Software engineers develop software systems for control and automation in manufacturing, business, and other areas.

Please indicate how important each of these items is for an entry level Computer Engineer.

130) Knowledge of Programming Languages

131) Knowledge of Assembly Language

132) Knowledge of C

133) Knowledge of C++

134) Knowledge of Most Effective Coding Styles

135) Knowledge of How Coding Affects Computer Systems Performance

136) Knowledge of Computer Engineering Foundations

137) Knowledge of Computer Hardware

138) Knowledge of Electronics Fundamentals

139) Knowledge of Computer System Performance Evaluation

140) Knowledge of Data Communication Fundamentals

141) Knowledge of Voice Communication Fundamentals

142) Knowledge of Techniques used in Systems Engineering

143) Knowledge of Software/hardware Interfaces

144) Knowledge of Networking

145) Knowledge of Operating Systems

146) Knowledge of Hardware/Software/OS Integration

147) Knowledge of Real Time Systems

148) Knowledge of Automation Control Technology

149) Knowledge of Programmable Logic Devices

150) Knowledge of Hardware Description Languages

151) Knowledge of Control Systems

152) Knowledge of Industrial Processes

153) Knowledge of Cross Platform Capabilities

154) Knowledge of Communication Protocols in Detail

155) Knowledge of Cost/Benefits

156) Ability to Program

157) Ability to Code in Assembly Language

158) Ability to Write Device Drivers

159) Ability to Flow Chart

160) Ability to Debug Software

161) Ability to use Computer Aided Software Engineering Software

162) Ability to Design

163) Ability to Discern Effective Hardware/Software/OS Trade-off

164) Ability to Design Solutions to Meet Specifications

165) Ability to Evaluate Strengths/Weaknesses of Operation Systems

166) Ability to Research Technology

167) Ability to Test/Repair

168) Ability to Test Integrated Hardware/Software Solutions

169) Ability to Troubleshoot hardware

170) Ability to Repair Hardware

171) Ability to Manage Projects

172) Ability to Use Project Management Tools Effectively

173) Ability to Give Effective Directions to Programmers

174) Ability to Create Technical Documentation

175) Ability to Use CAD

176) Ability to Integrate Hardware/Software

Database Administrators set up computer databases and test and coordinate changes to them and determine ways to organize and store data.

Please indicate how important each of these items is for an entry level Database Administrator.

177) Knowledge of Database Management Systems

178) Knowledge of Sybase

179) Knowledge of Oracle

180) Knowledge of SQL

181) Knowledge of Access

182) Knowledge of Informix

183) Knowledge of Multiple DBMS

184) Knowledge of Database Normalization

185) Knowledge of Database Optimization

186) Knowledge of Data Mining

187) Ability to Design Databases to Meet Specifications

188) Ability to Manage Database

189) Ability to Import/Export Data

190) Ability to Build Tables and Indexes

191) Ability to Generate Custom Reports

192) Ability to Manage Data Conversions

193) Ability to Trouble Shoot

194) Ability to Optimize Performance

195) Ability to Manage Cross Platform Databases

196) Ability to Perform Cost/Benefit Analysis

Computer Support Specialists provide marketing and technical assistance, support, and advice to clients and users such as software services consulting.

Please indicate how important each of these items is for an entry level Computer Support Specialist.

197) Knowledge of the Impact of Technology on Business

198) Knowledge of Business Communication

199) Knowledge of Customer Software

200) Knowledge of Computer Hardware

201) Knowledge of Presentation Software

202) Knowledge of Customer's Industry

203) Knowledge of Programming

204) Ability to Solve Problems

205) Ability to Visualize User Problems

206) Ability to Differentiate User Error/Hardware/Software Problems

207) Ability to Use Web Search Engines

208) Ability to Walk the User Through a Solution in Layman's Terms

209) Ability to Improvise Solutions

210) Ability to Exercise Interpersonal Skills

211) Ability to Calm the End User

212) Ability to Exercise Patience

213) Ability to Listen Empathetically

214) Ability to Relate to Diverse Audiences

215) Ability to Configure a PC

216) Ability to Use Presentation Software

217) Ability to Document Help Tasks

218) Ability to Think Fast in a Stressful Situation

Network Specialists design, install, and support an organization's distributed computing (LAN, WAN, network segment, or Internet system). Network and data communications analysts design, test, and evaluate network systems and perform modeling, analysis, and planning.

Please indicate how important each of these items is for an entry level Network Specialist.

219) Knowledge of Network Protocols

220) Knowledge of Networking Hardware

221) Knowledge of Operating Systems

222) Knowledge of Novell NetWare

223) Knowledge of Windows NT

224) Knowledge of UNIX

225) Knowledge of Communication Fundamentals

226) Knowledge of Basic Communication Debugging

227) Knowledge of Connectivity Methods

228) Knowledge of Network Security Issues

229) Knowledge of Networking/Product Relationships

230) Knowledge of Techniques of Systems Engineering

231) Knowledge of Communication Software

232) Knowledge of Communication Media

233) Ability to Design

234) Ability to Design LAN

235) Ability to Design WAN

236) Ability to Analyze Network Needs

237) Ability to Flowchart/Diagram

238) Ability to Manage the Network

239) Ability to Troubleshoot

240) Ability to Monitor Networks

241) Ability to Use Test Equipment

242) Ability to Configure Network Components

243) Ability to Optimize Network Performance

244) Ability to Interact With Vendors

245) Ability to Manage/Schedule Time

246) Ability to Pass Network Certification

Telecommunications Analysts focus on the interaction between computer and communications equipment.

Please indicate how important each of these items is for an entry level Telecommunications Analyst

247) Knowledge of Signal Analysis

248) Knowledge of Signal Encoding

249) Knowledge of Signal Noise Analysis and Bit Rate Errors

250) Knowledge of Telecommunication Hardware

251) Knowledge of Telecommunications Software

252) Knowledge of Fundamentals of Electronics

253) Knowledge of Telecommunications Protocol

254) Knowledge of Signaling Systems such as SS-7

255) Knowledge of Telco Operations and Networks

256) Knowledge of Evolving Telecommunication Technologies

257) Knowledge of Basics of Communications

258) Knowledge of Computing Fundamentals

259) Ability to Troubleshoot in a Wide Geographic Area

260) Ability to Design

261) Ability to Design Communication Network Using a Variety of Technologies

262) Ability to Flow Chart and Diagram

263) Ability to Design Cost Effective Communication Networks

264) Ability to Design/Layout Telecom Cabling Scheme

265) Ability to Research New Technologies

266) Ability to Deal with Telcos and Vendors

267) Ability to Interface OS and Communication Devices

268) Ability to Understand Telcom System Flow

Internet Specialists are involved in the design, development, and maintenance of Web sites and their servers. Typical jobs include Webmasters who are responsible for all technical aspects of the Web site and Web Developers who are responsible for site design and creation.

Please indicate how important each of these items is for an entry level Internet Specialist.

269) Knowledge of Languages

270) Knowledge of Scripting Languages

271) Knowledge of Java

272) Knowledge of Markup Languages

273) Knowledge of HTML

274) Knowledge of DHTML

275) Knowledge of XML

276) Knowledge of ASP, CGI, PERL

277) Knowledge of C/C++

278) Knowledge of Networks

279) Knowledge of How Web Applications are Affected by Bandwidth

280) Knowledge of Operating Systems

281) Knowledge of Windows NT

282) Knowledge of Windows 95/98

283) Knowledge of UNIX

284) Knowledge of Web Monitoring Tools

285) Knowledge of Web Security

286) Knowledge of Internet Browsers

287) Knowledge of User Interface Design Principles

288) Knowledge of Basic Client Server Technology

289) Knowledge of Databases

290) Knowledge of Design Principles

291) Knowledge of Multimedia Design Technologies

292) Knowledge of Cross Platform Usage

293) Ability to Design

294) Ability to Design Still and Motion Graphics

295) Ability to Design Esthetic and Functional Web Pages

296) Ability to Design Code for High Volume Circumstances

297) Ability to Write

298) Ability to Write Efficient Code that Reduces Downtime

299) Ability to Write Browser Independent Code

300) Ability to Code in Multiple Languages

301) Ability to Link Web Pages to Databases

302) Ability to Write Java Applets

303) Ability to Meet Customer Needs

304) Ability to Meet Customer Design Specifications

305) Ability to Match Web Solutions to Customer Objectives

306) Ability to Communicate with User to Determine Needs

307) Ability to Perform Field Validation on the Client

308) Ability to Integrate Audio Technologies

309) Ability to Analyze and Troubleshoot

Thank you for your support. Your input will be valuable as the Committee begins to create the curriculum for this program.

This survey was produced with WebSurveyor

Highest level of education achieved:
Type: Single Choice

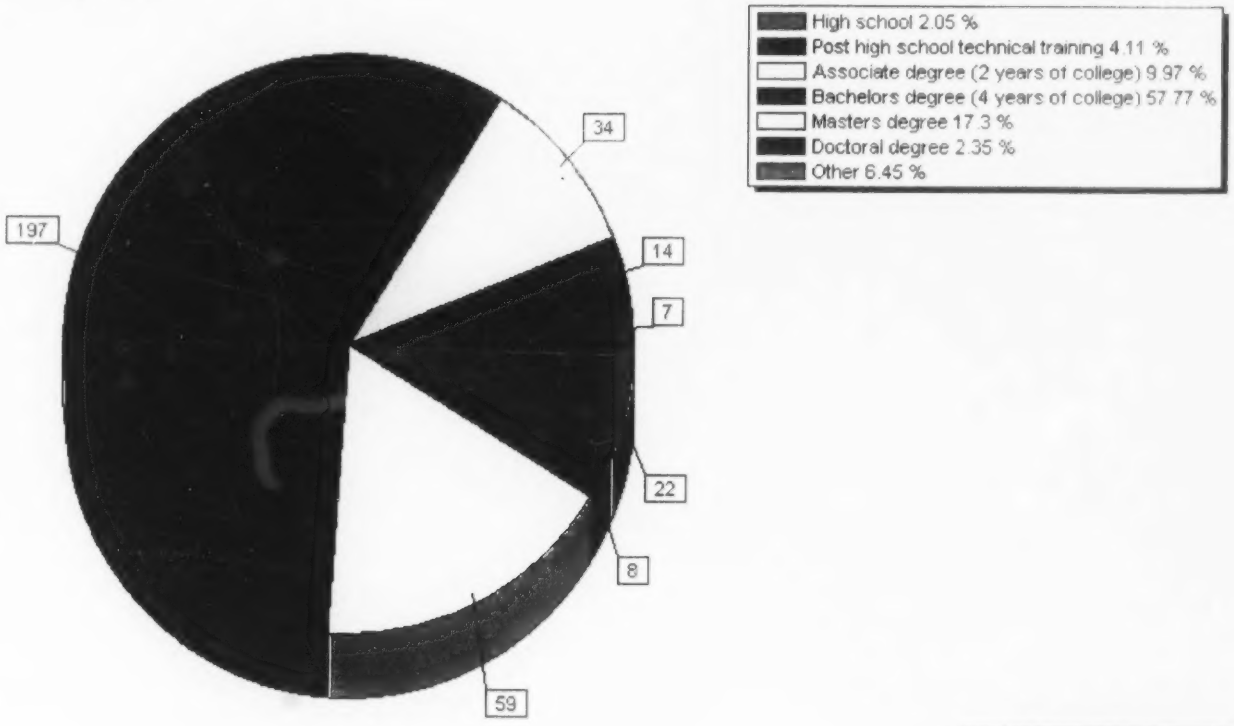

FIGURE 1

Which of the following job clusters best describe your area?
Type: Single Choice

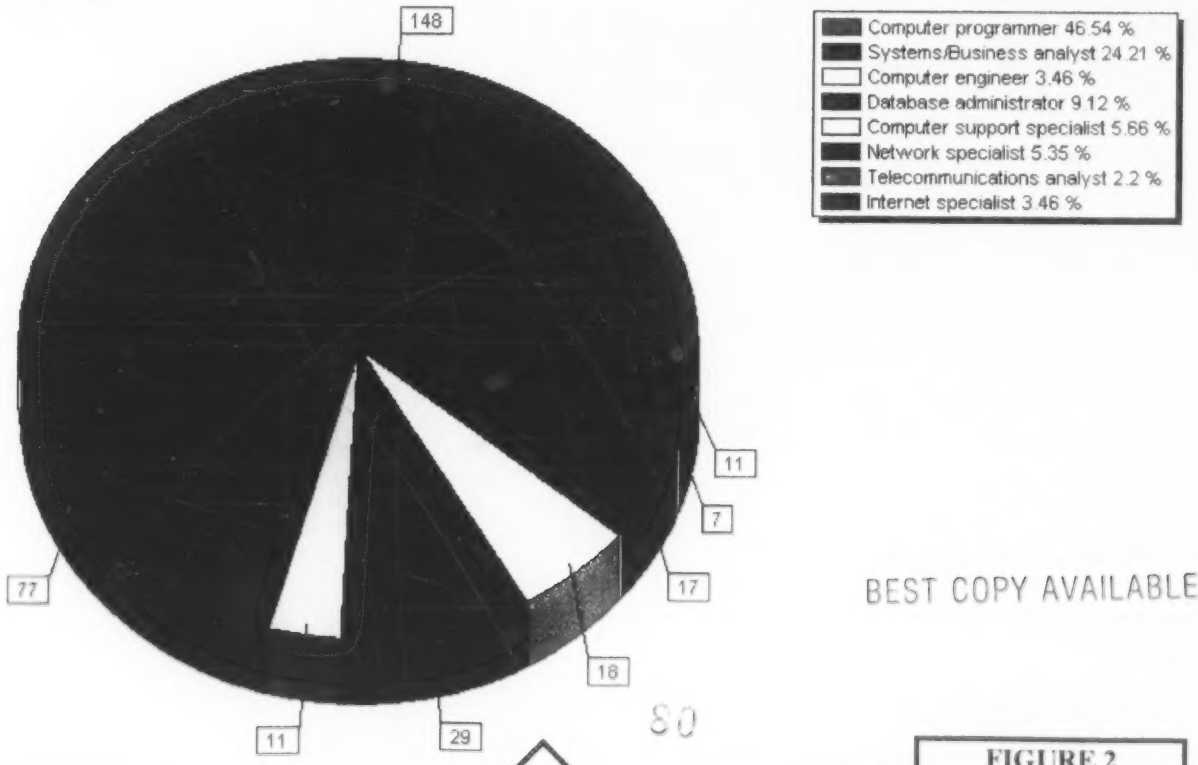

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FIGURE 2

Please indicate the primary computer programming languages that you use regularly in your job.
Type: Multiple Choice

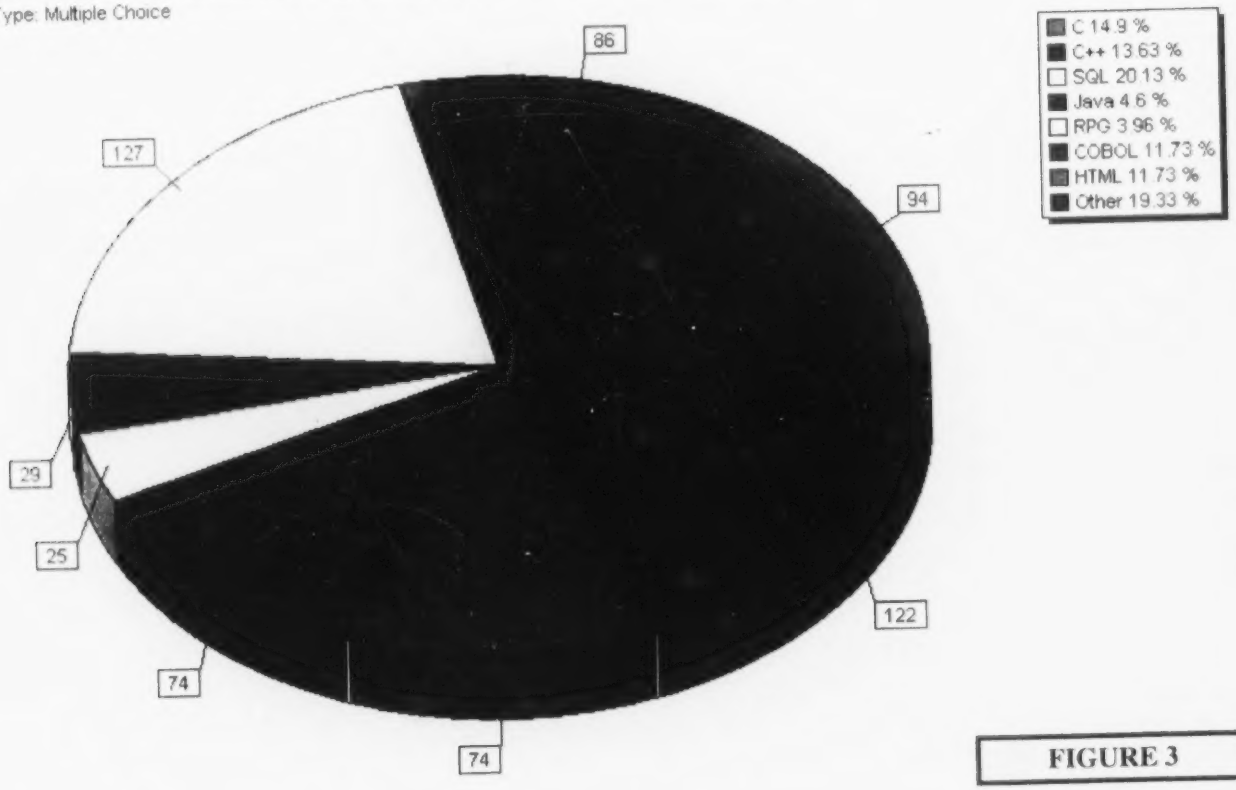

FIGURE 3

Problem solving process (decision tree, problem identification, analysis, solving)
Type: Single Choice

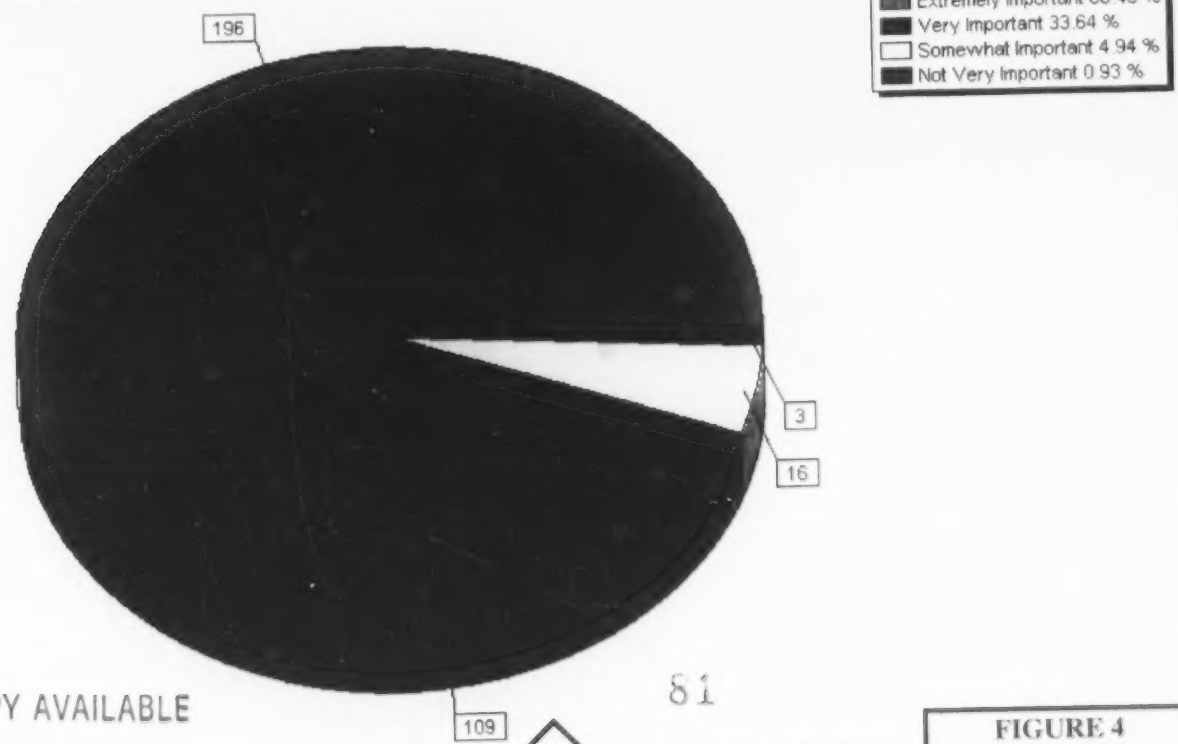

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FIGURE 4

Listening
Type: Single Choice

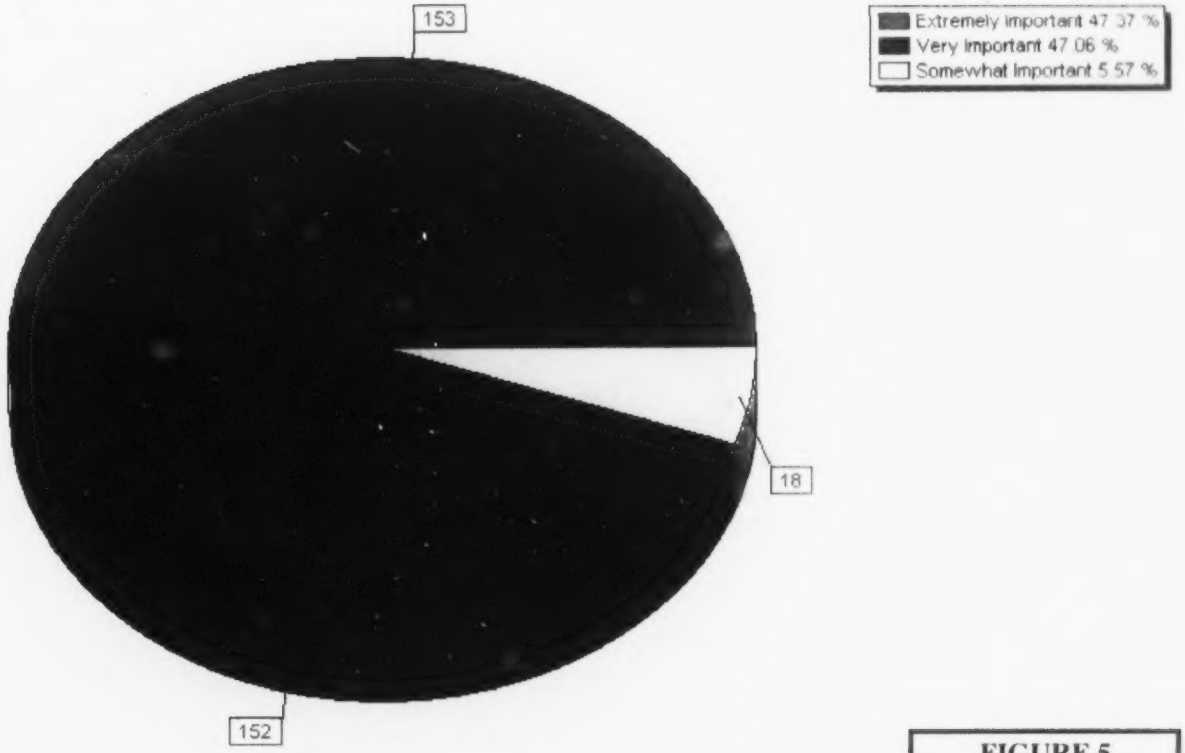

FIGURE 5

Team Work (long term)
Type: Single Choice

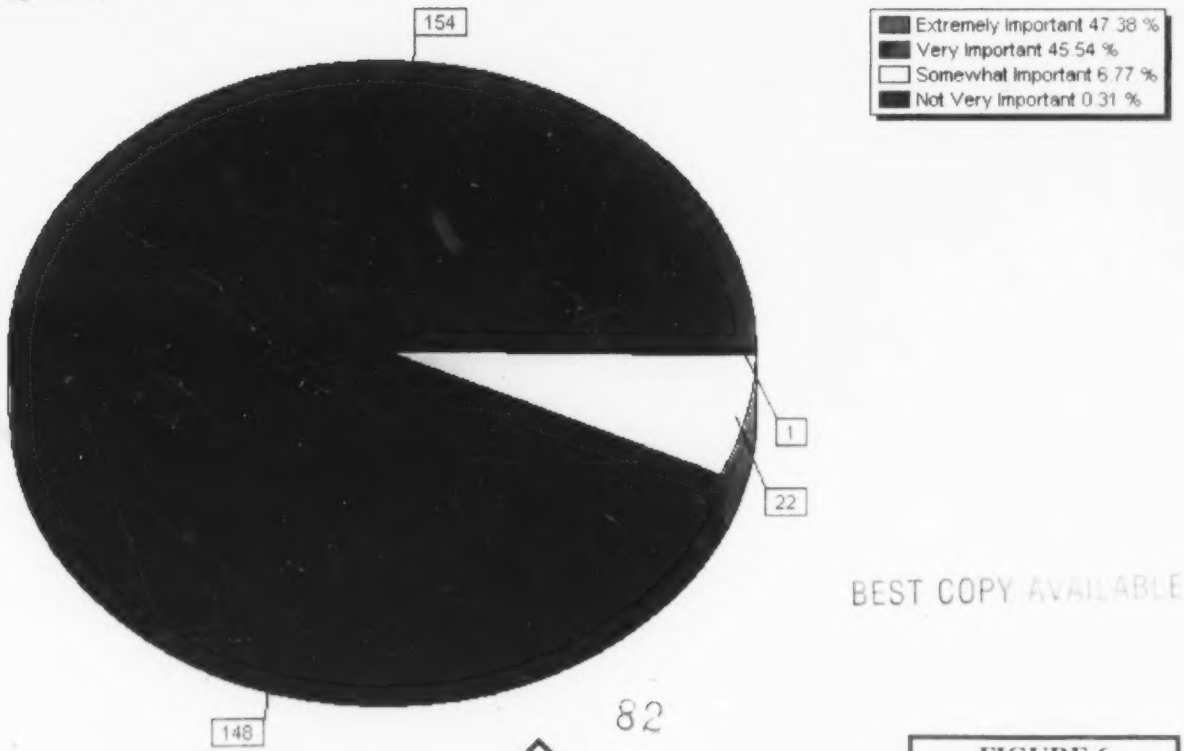

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FIGURE 6

Adaptability to new technology, new languages
Type: Single Choice

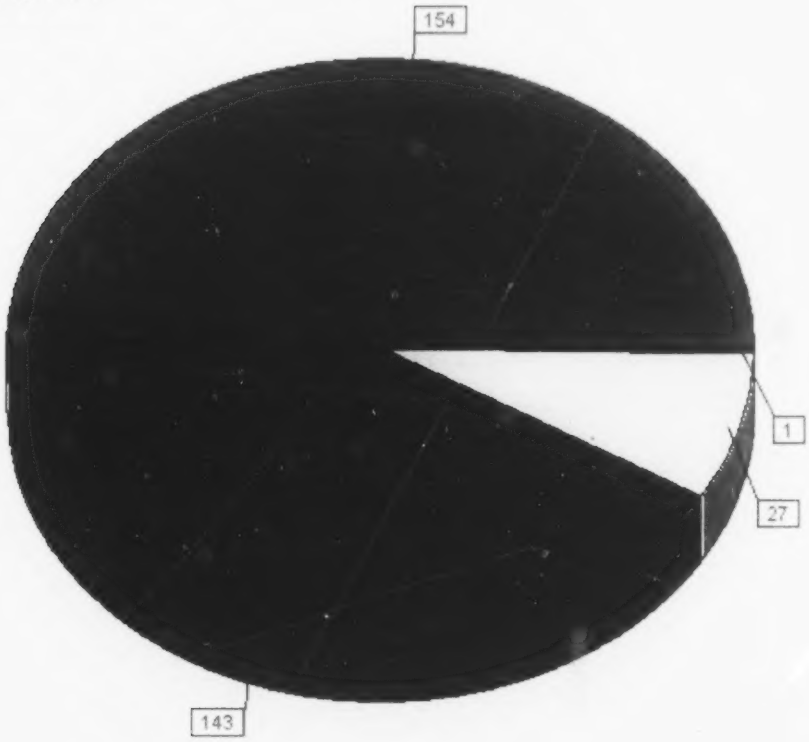

FIGURE 7

"Be the customer" mentality
Type: Single Choice

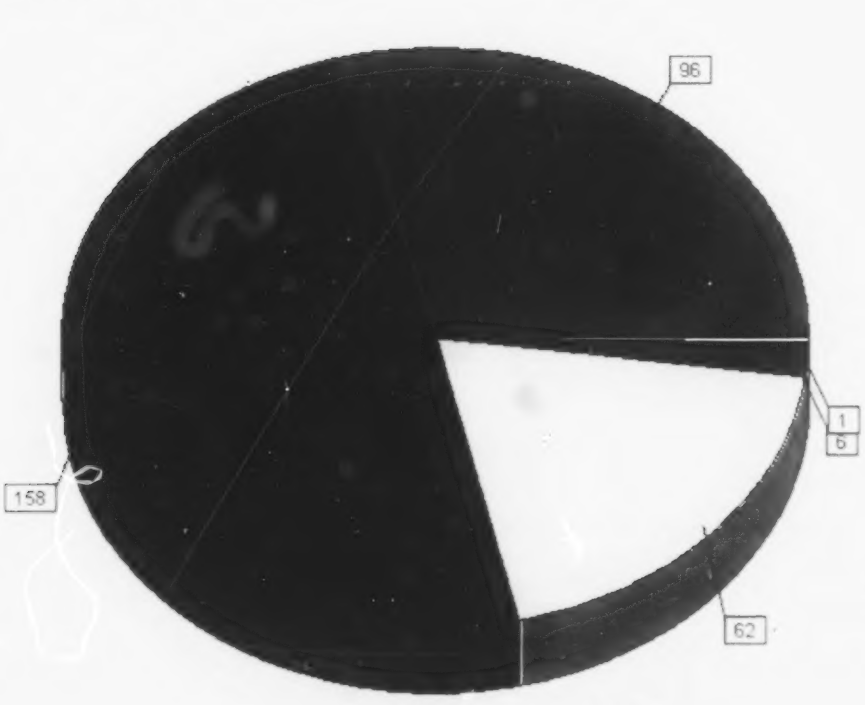

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FIGURE 8

Investigative skills (probing questions)
Type: Single Choice

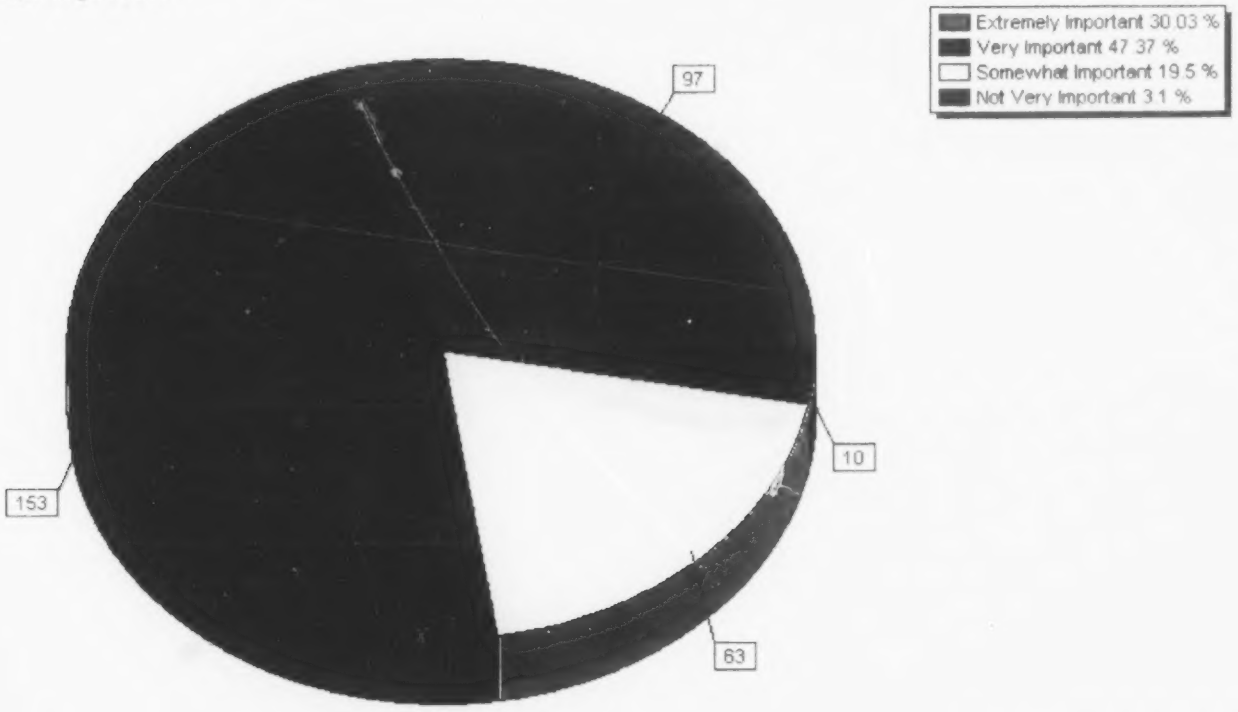

FIGURE 9

Idea initiation
Type: Single Choice

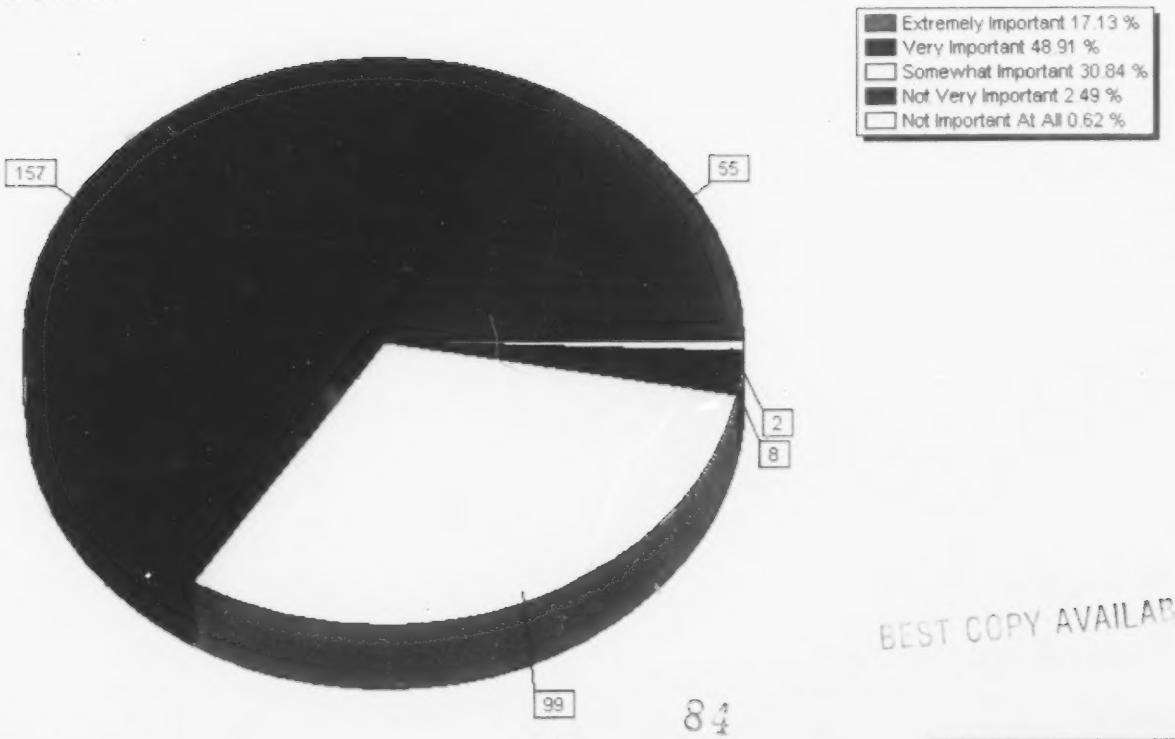

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FIGURE 10

Project Management
Type: Single Choice

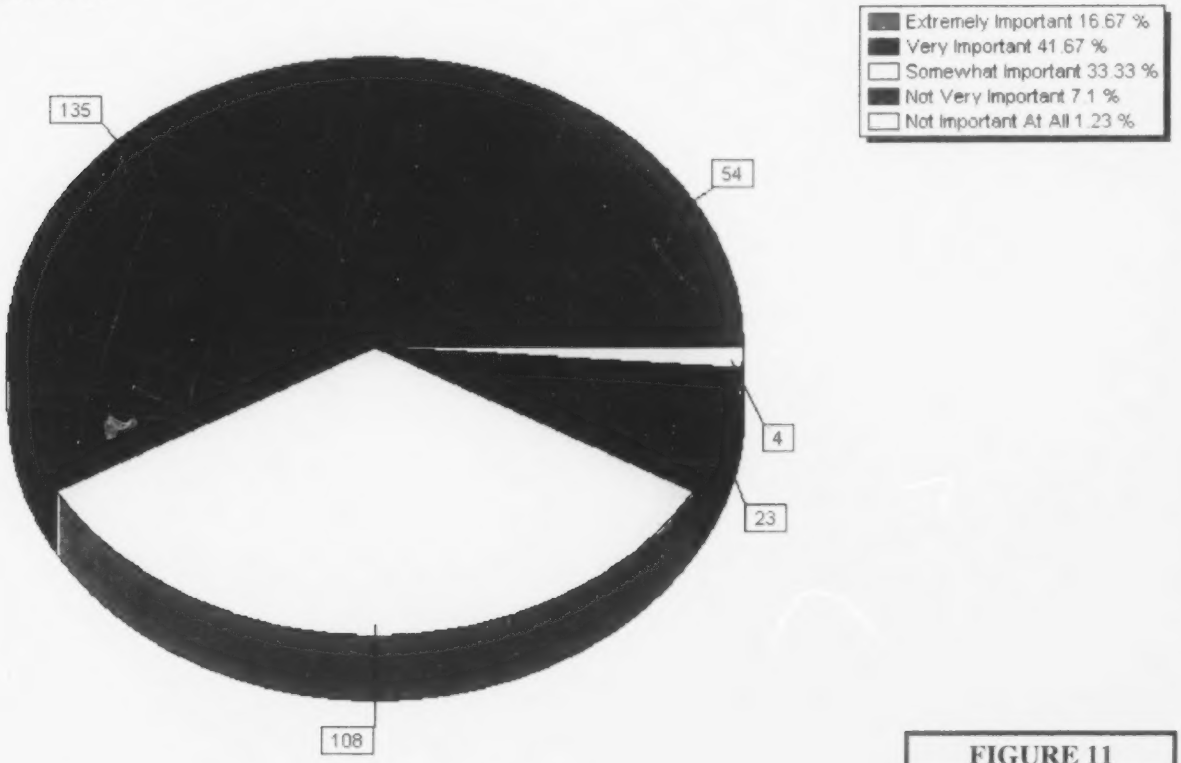

FIGURE 11

Ability to Code Programs
Type: Single Choice

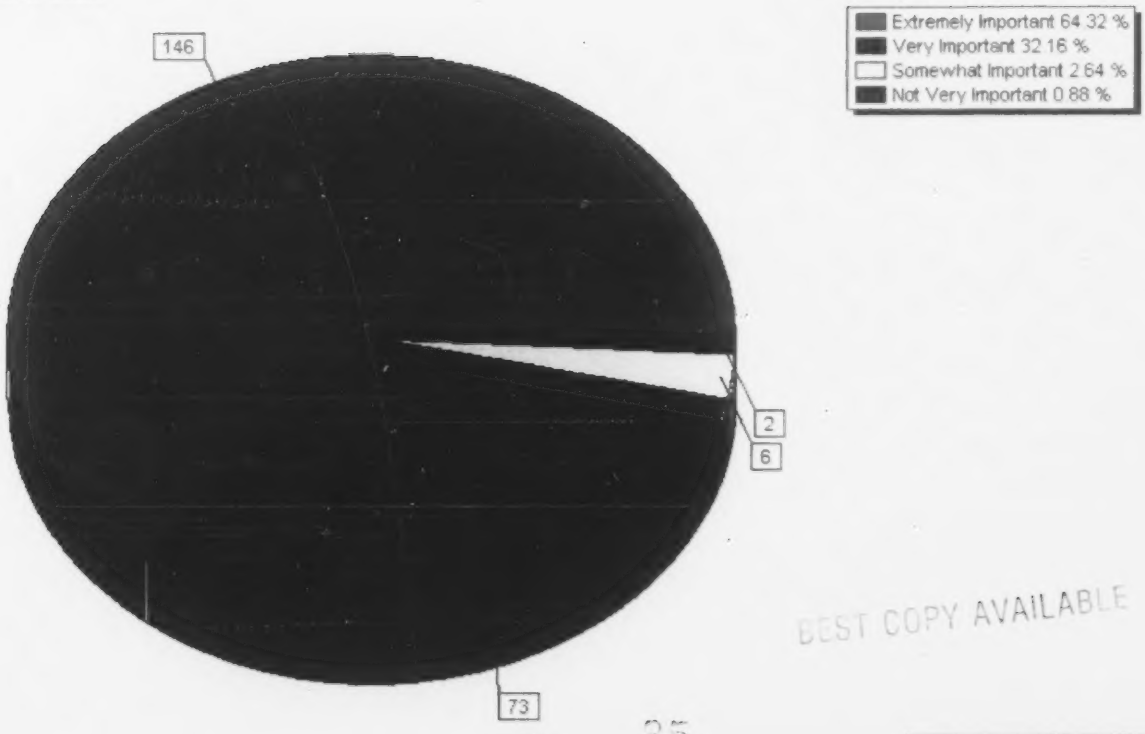

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FIGURE 12

Ability to Code Programs
Type: Single Choice

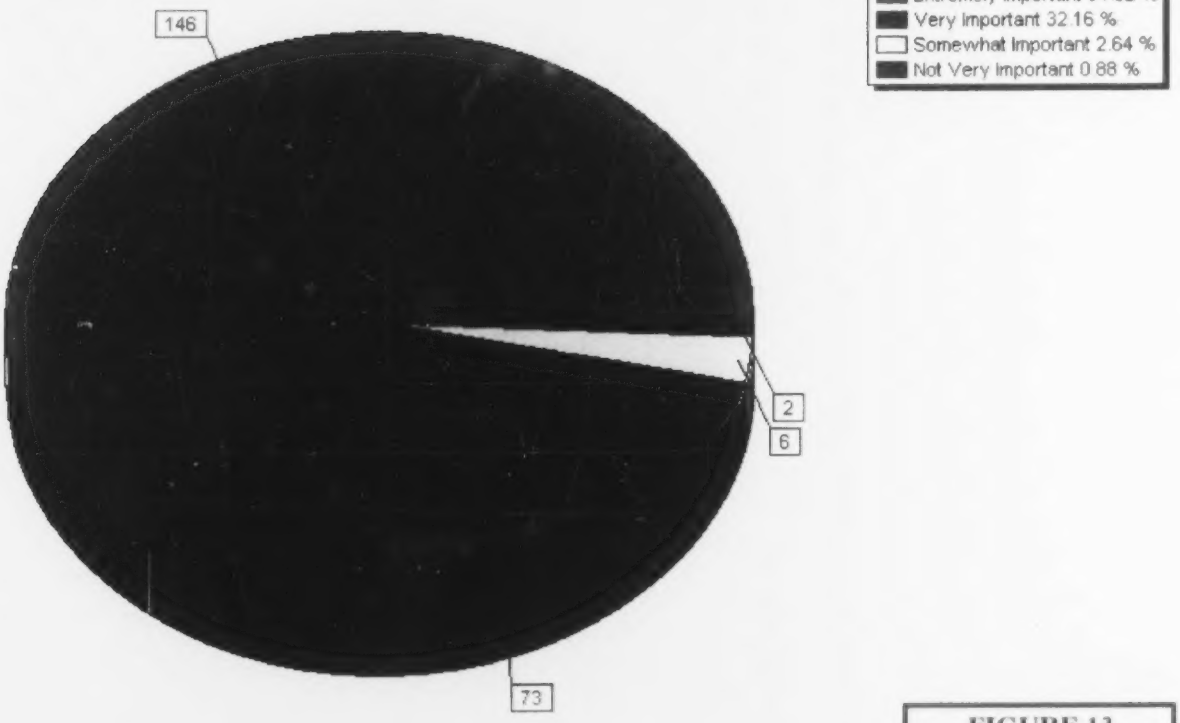

FIGURE 13

Ability to Read, Understand and Modify Programs Written by Others
Type: Single Choice

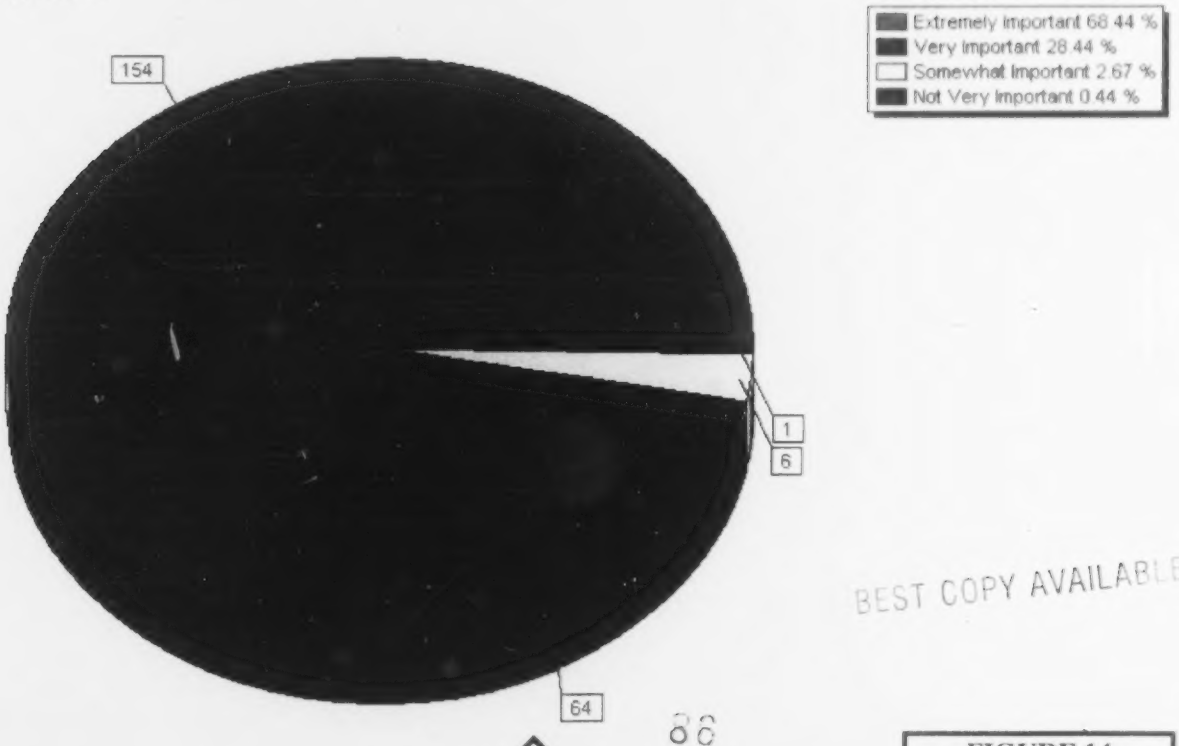

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FIGURE 14

Ability to Debug Software
Type: Single Choice

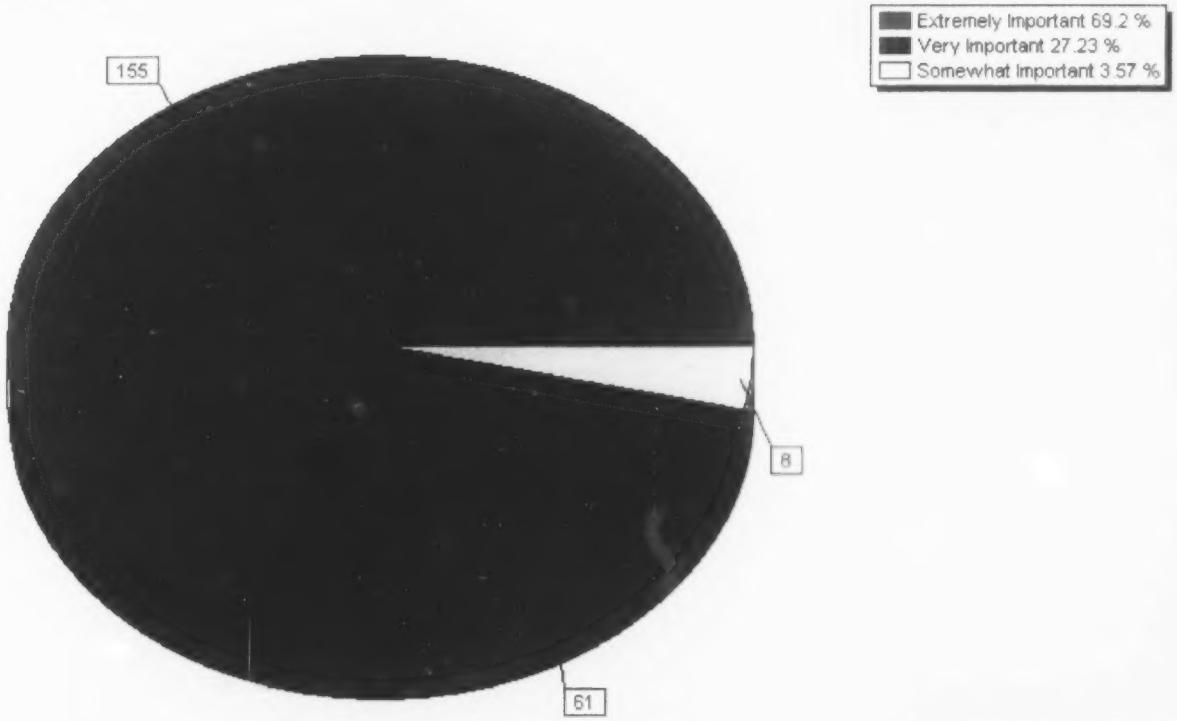

FIGURE 15

Knowledge of Structured Programming Fundamentals
Type: Single Choice

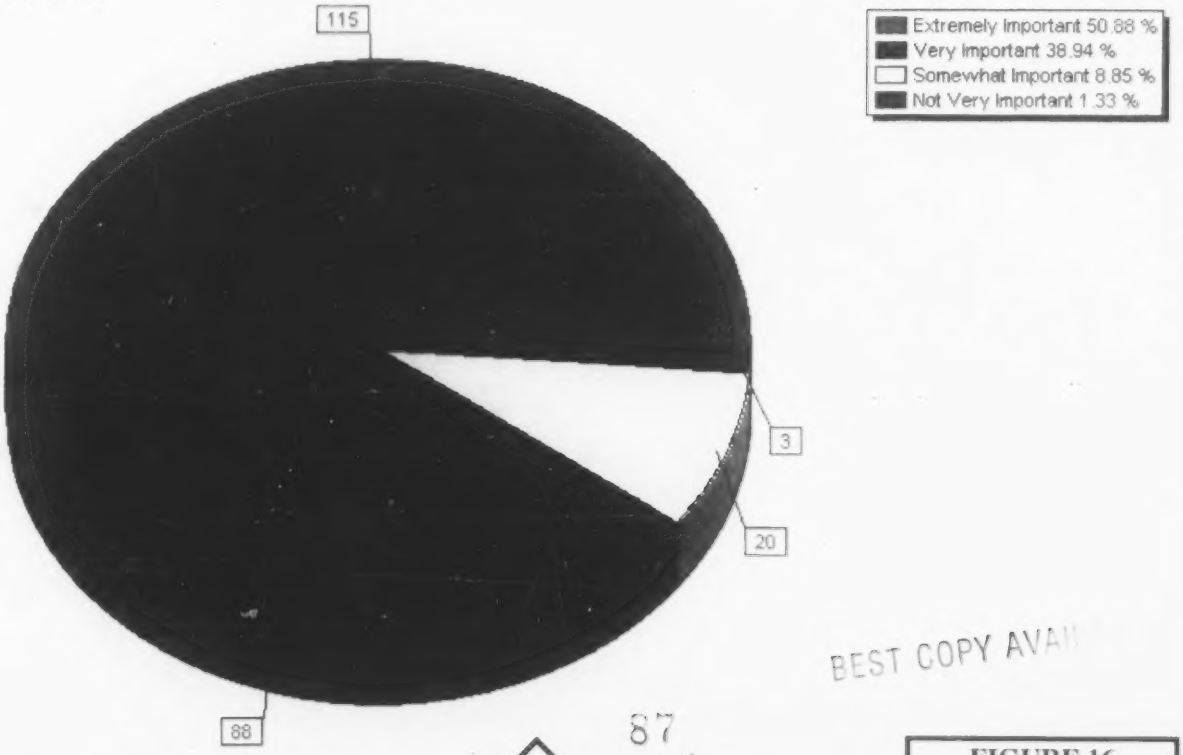

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FIGURE 16

Ability to Ask Probing Questions to Determine Customer Needs
Type: Single Choice

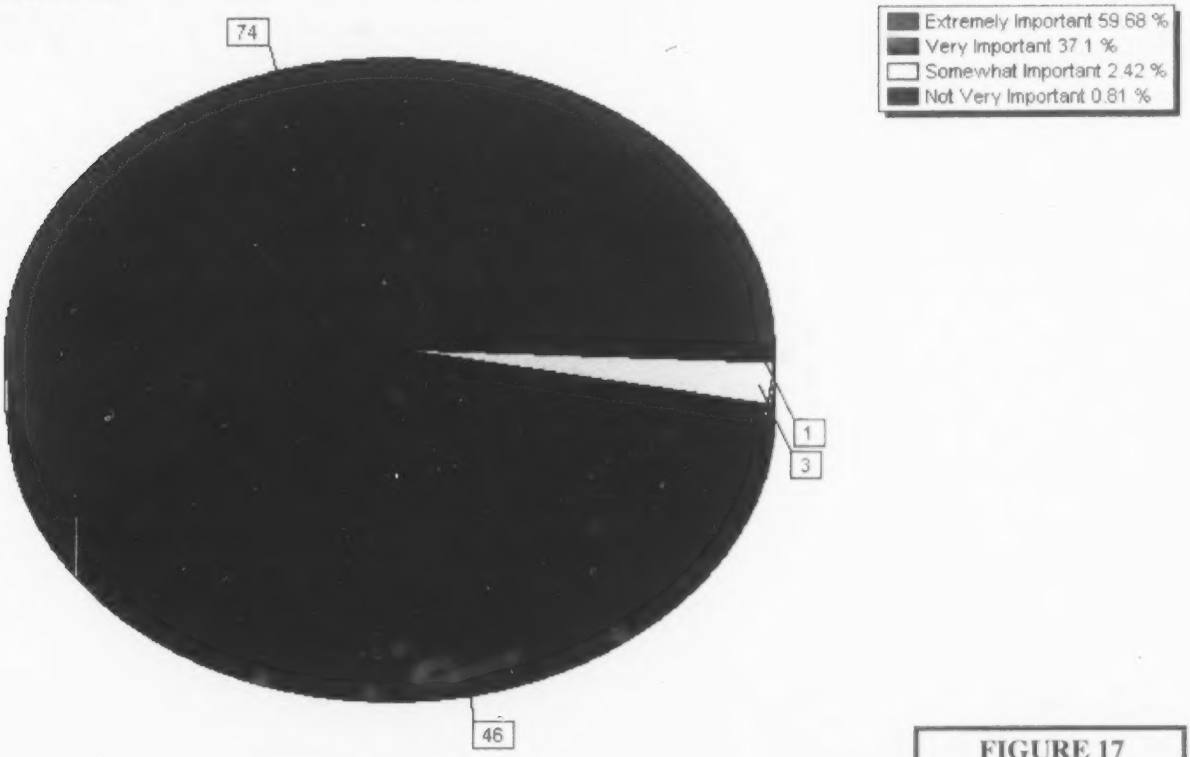

FIGURE 17

Ability to Maintain Open Communication with Customers
Type: Single Choice

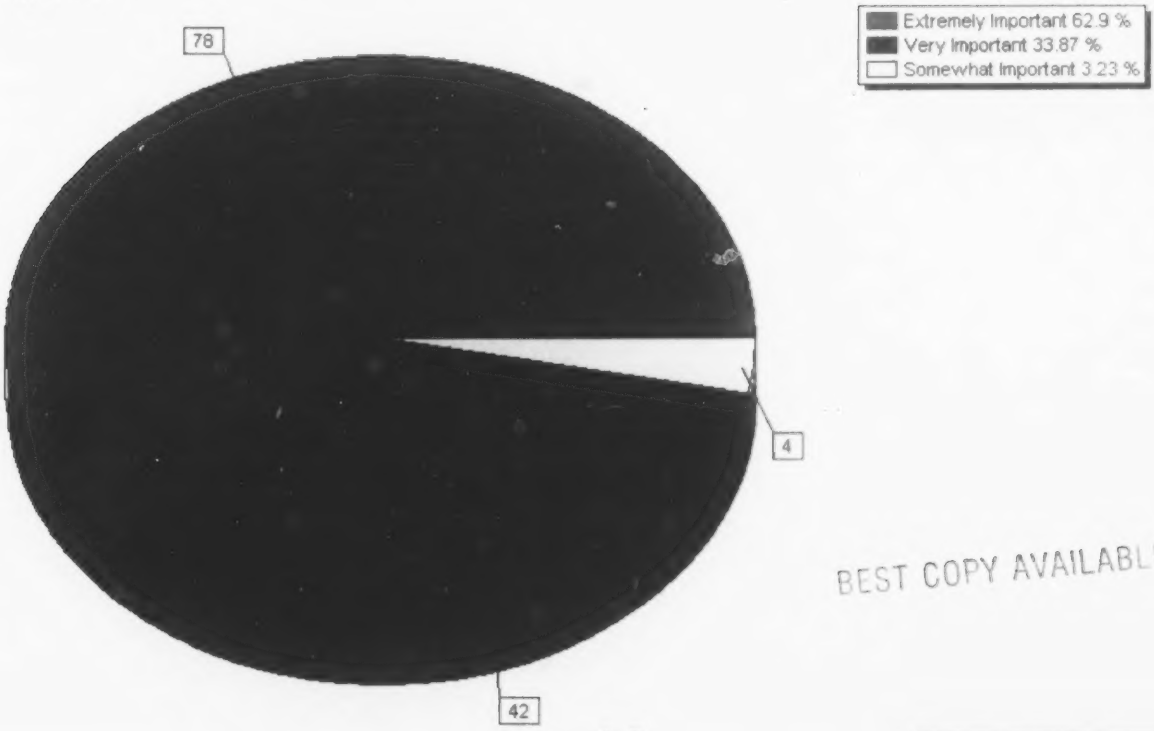

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FIGURE 18

Ability to Communicate with Customers
Type: Single Choice

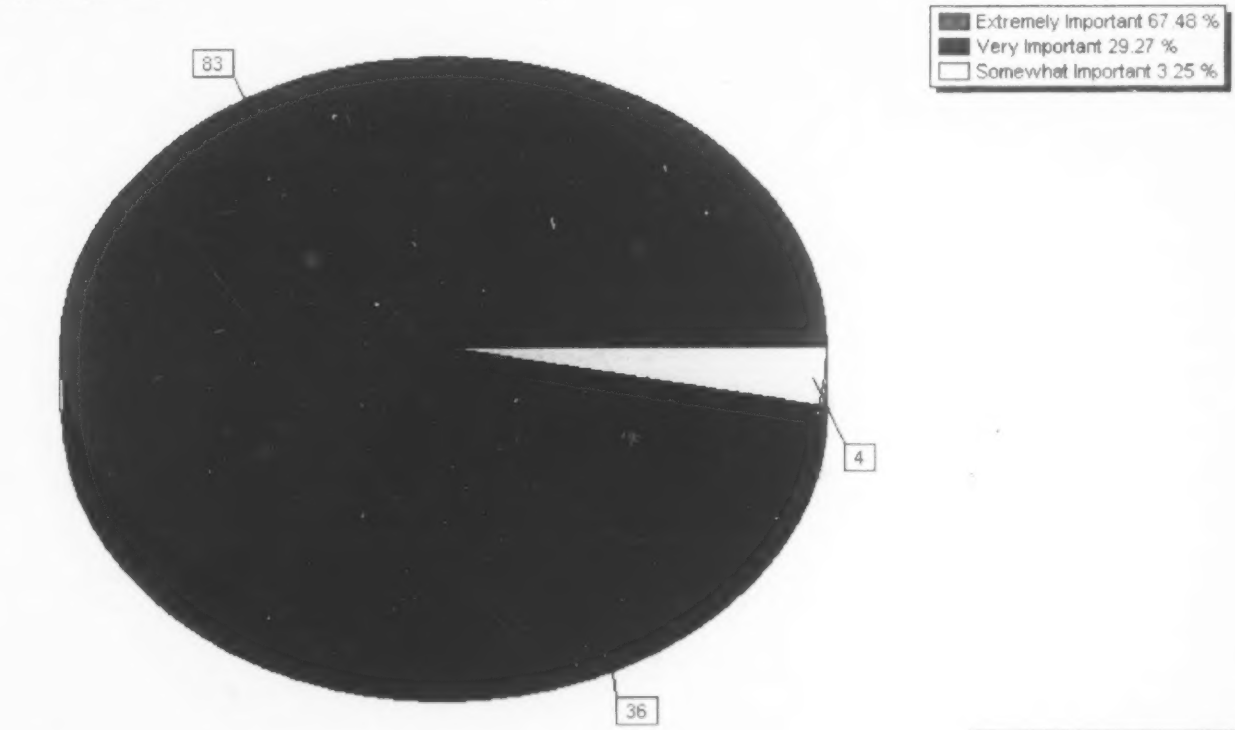

FIGURE 19

Ability to Design Solutions to Meet Specifications
Type: Single Choice

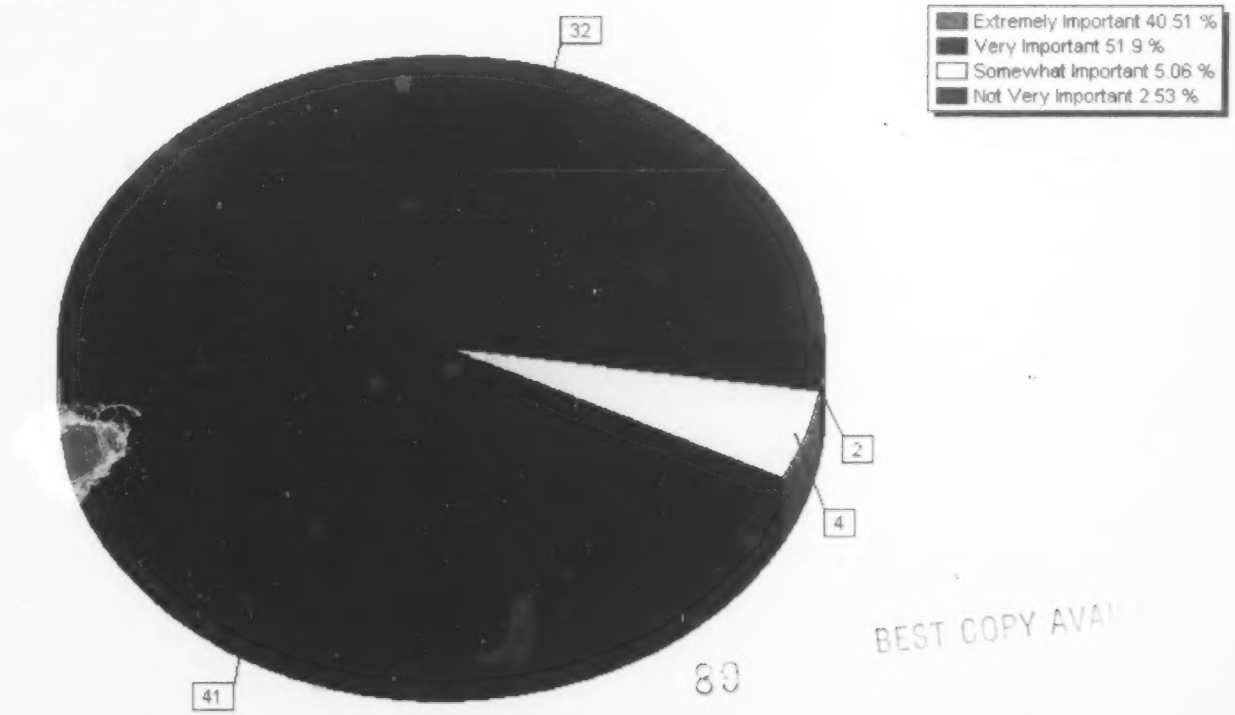

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FIGURE 20

Knowledge of Programming Languages
Type: Single Choice

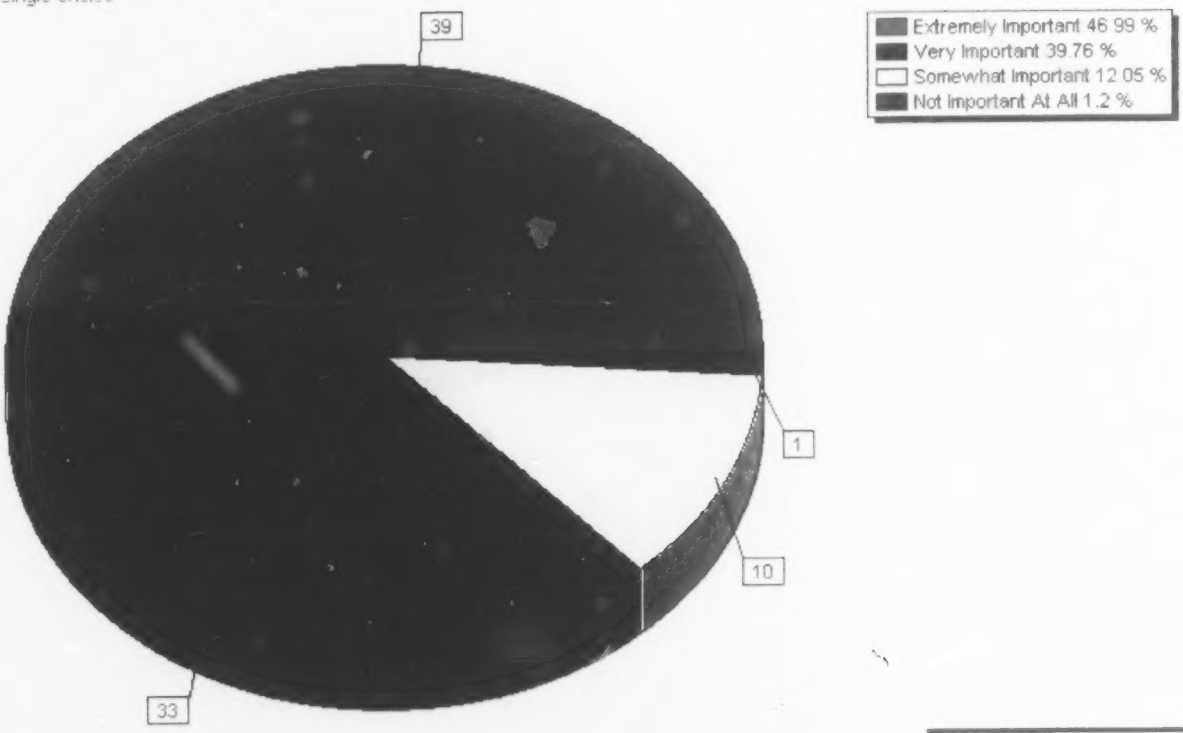

FIGURE 21

Ability to Debug Software
Type: Single Choice

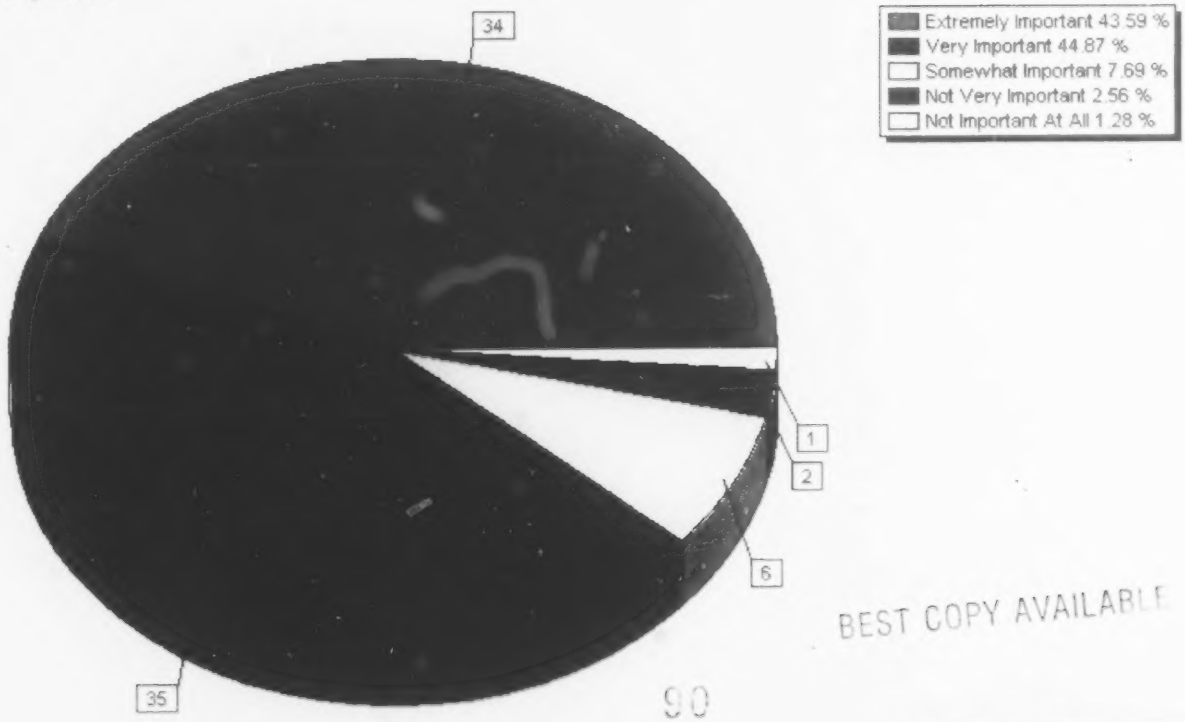

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FIGURE 22

Ability to Program
Type: Single Choice

FIGURE 23

Knowledge of Database Management Systems
Type: Single Choice

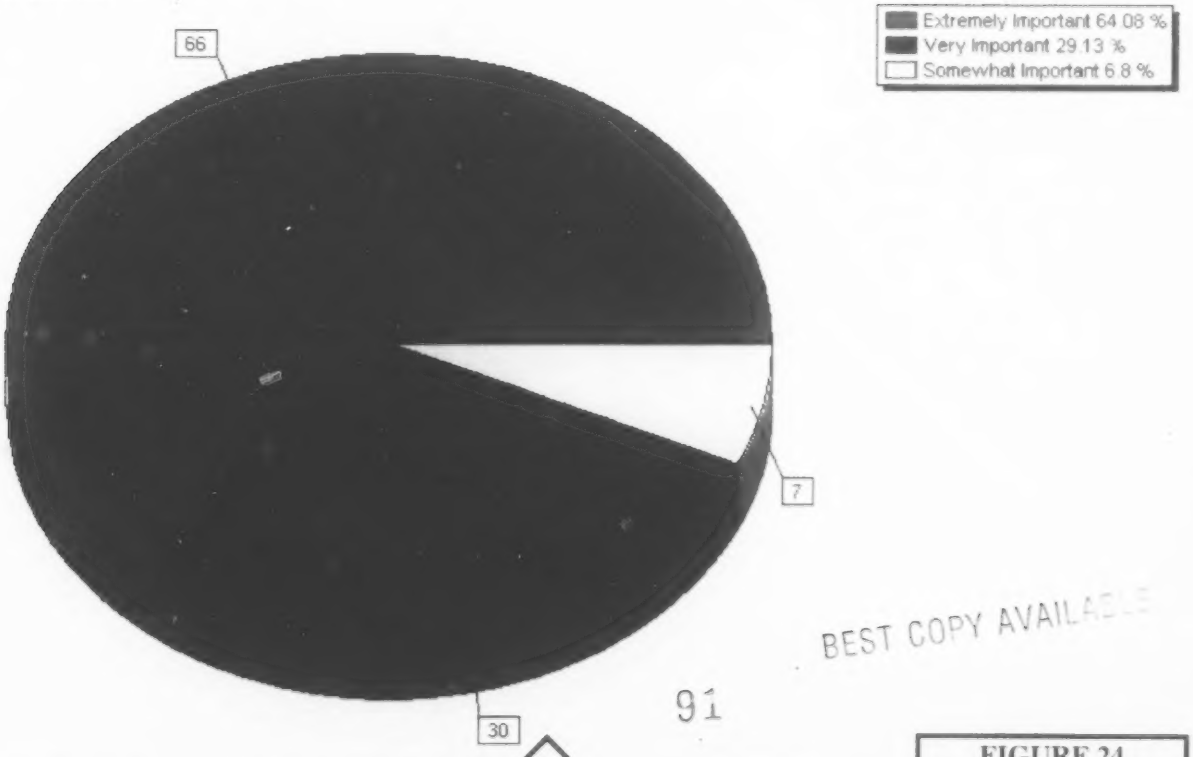

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FIGURE 24

Ability to Build Tables and Indexes
Type: Single Choice

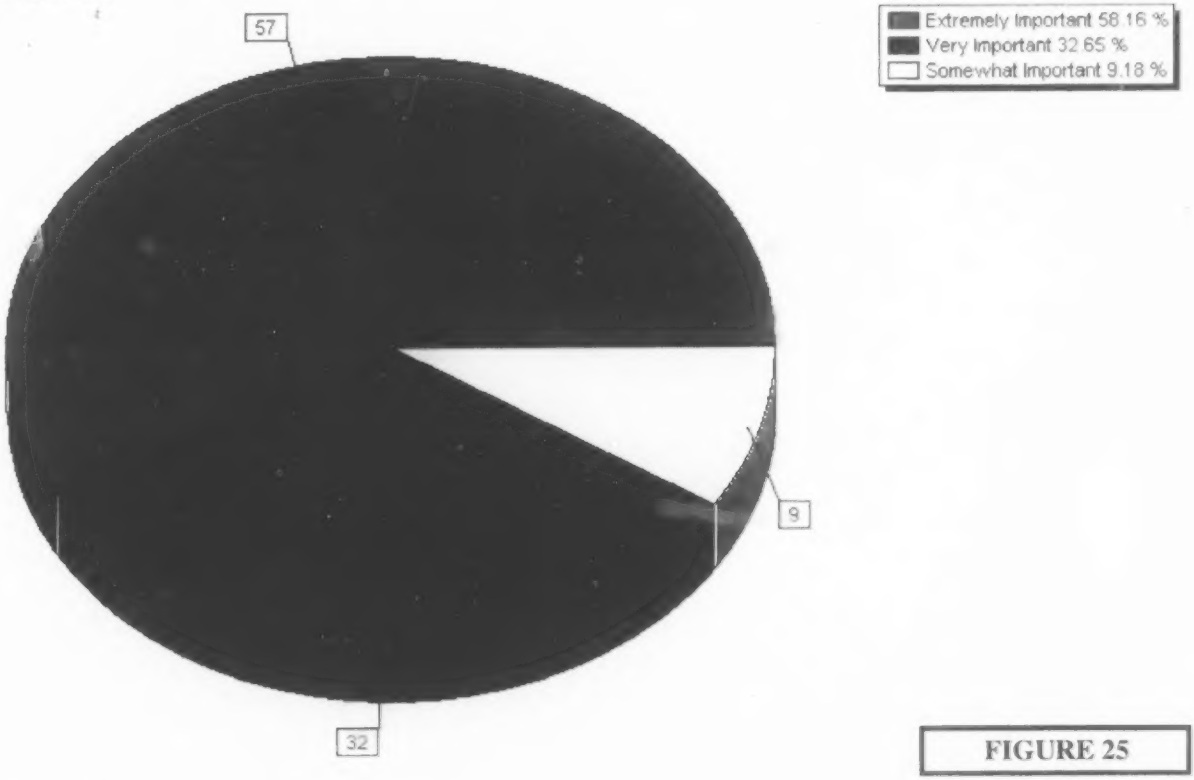

FIGURE 25

Knowledge of SQL
Type: Single Choice

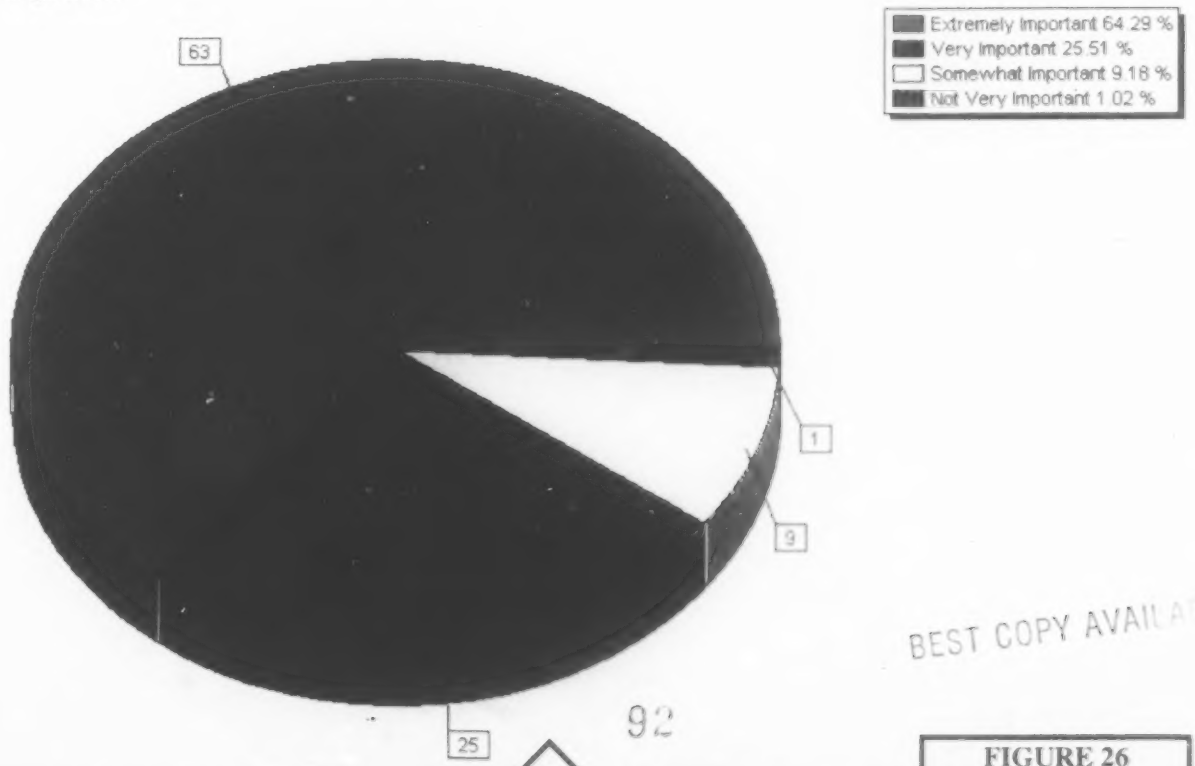

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FIGURE 26

Ability to Design Databases to Meet Specifications
Type: Single Choice

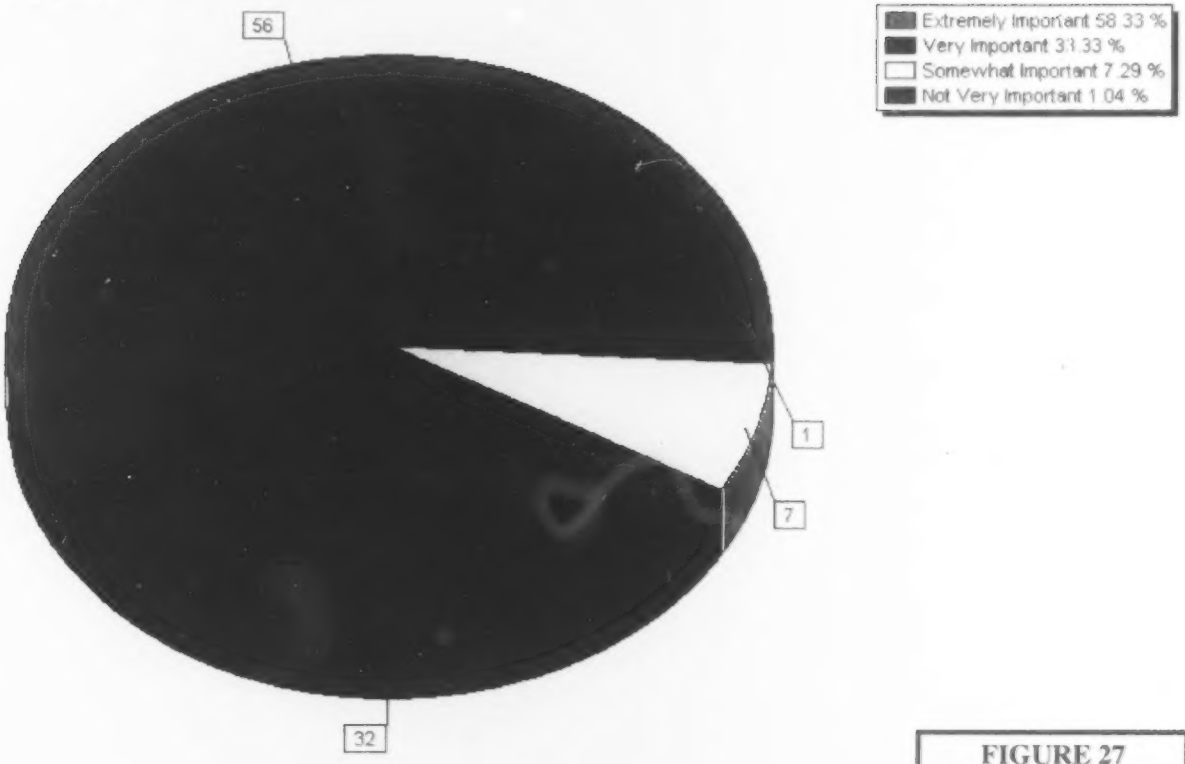

FIGURE 27

Ability to Visualize User Problems
Type: Single Choice

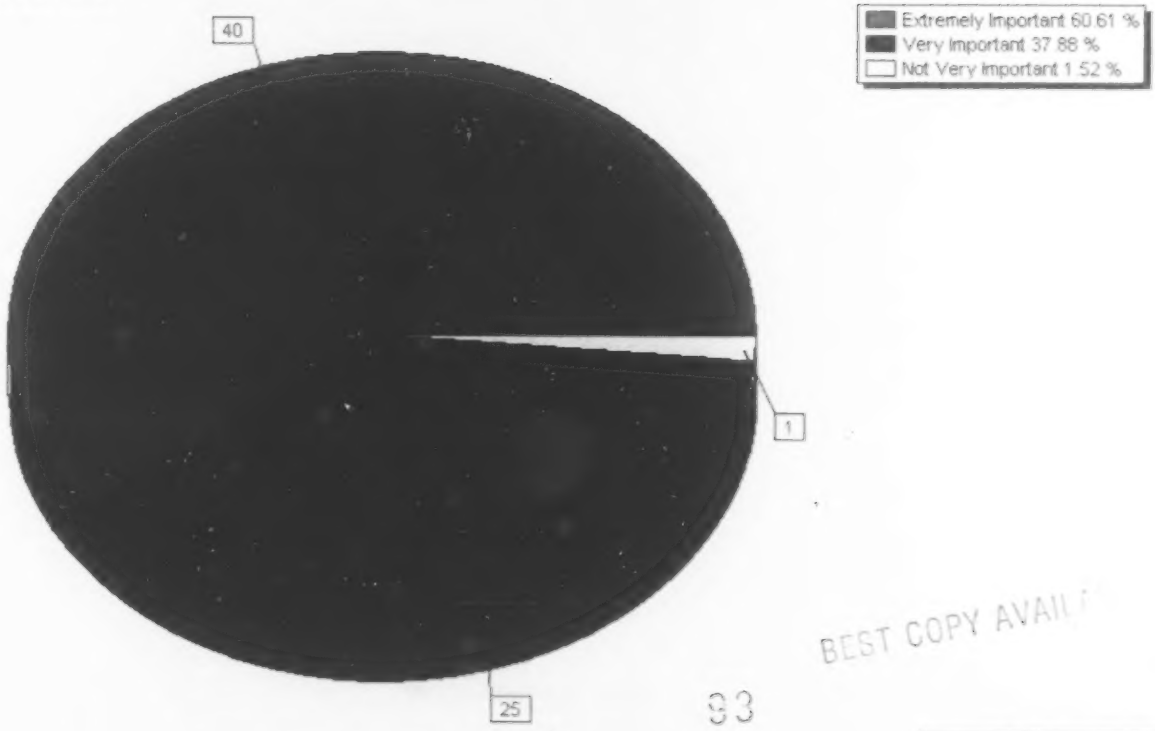

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FIGURE 28

Ability to Walk the User Through a Solution in Layman's Terms
Type: Single Choice

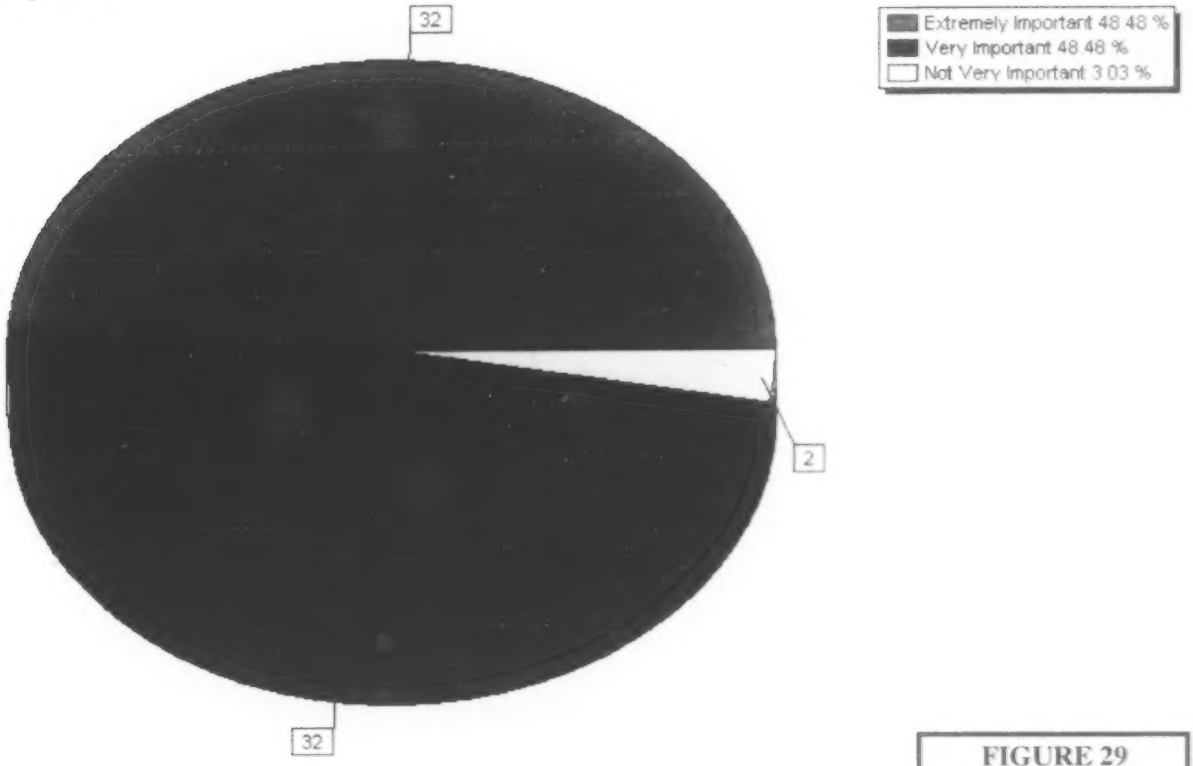

FIGURE 29

Ability to Solve Problems
Type: Single Choice

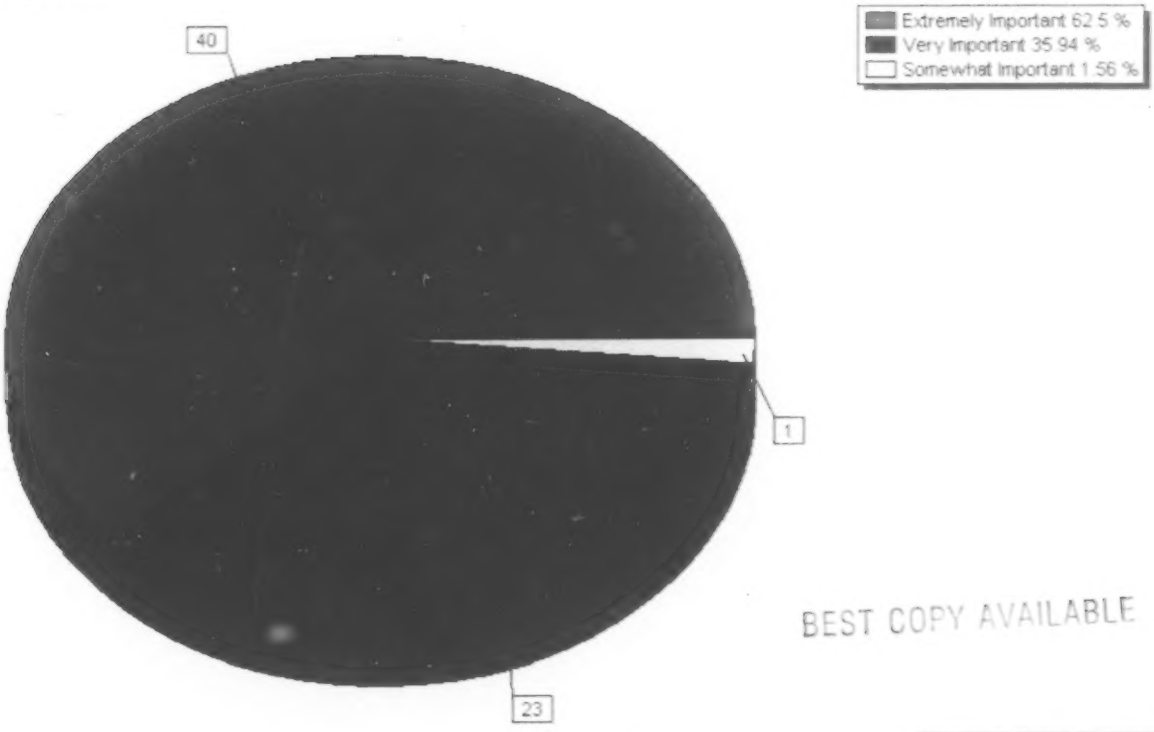

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FIGURE 30

Ability to Exercise Patience
Type: Single Choice

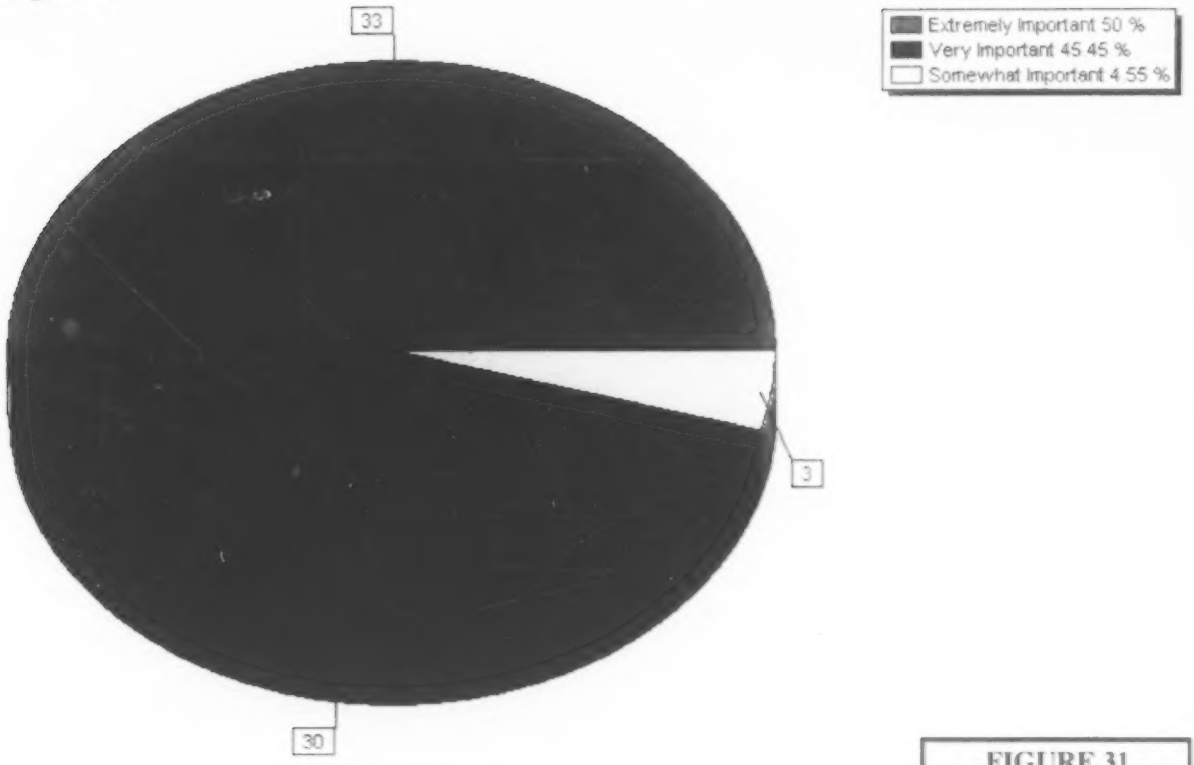

FIGURE 31

Knowledge of Network Protocols
Type: Single Choice

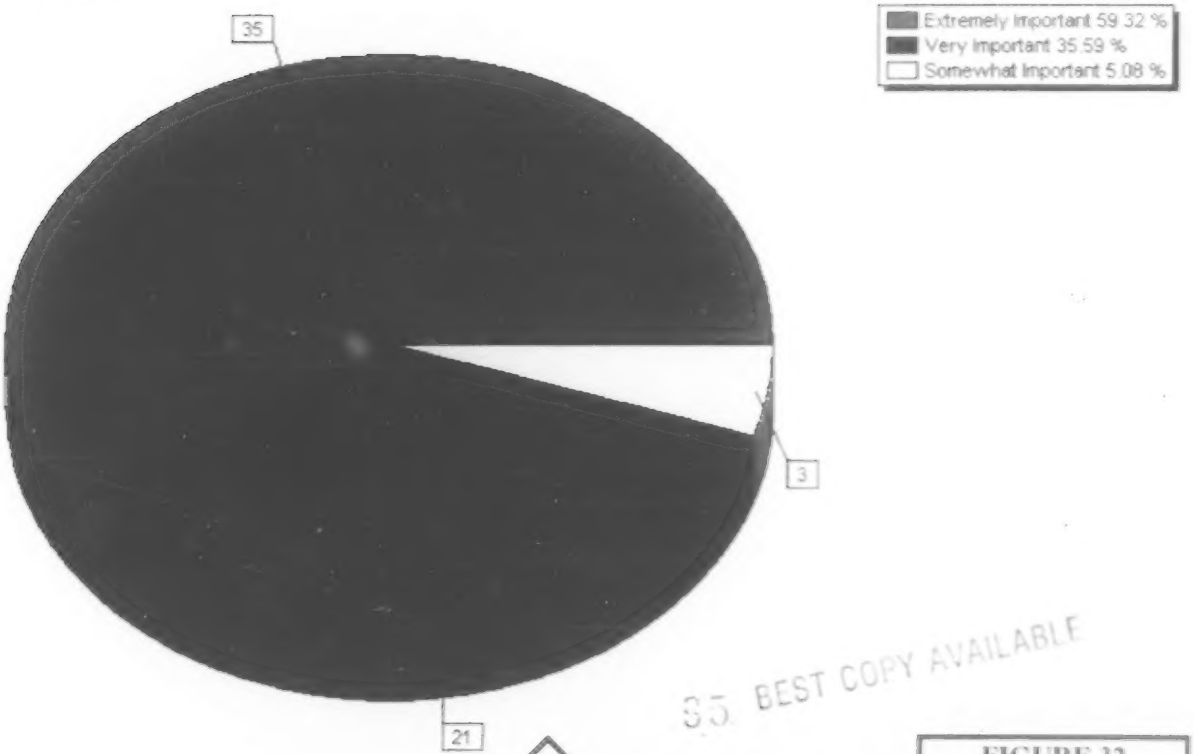

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FIGURE 32

Knowledge of Networking Hardware
Type: Single Choice

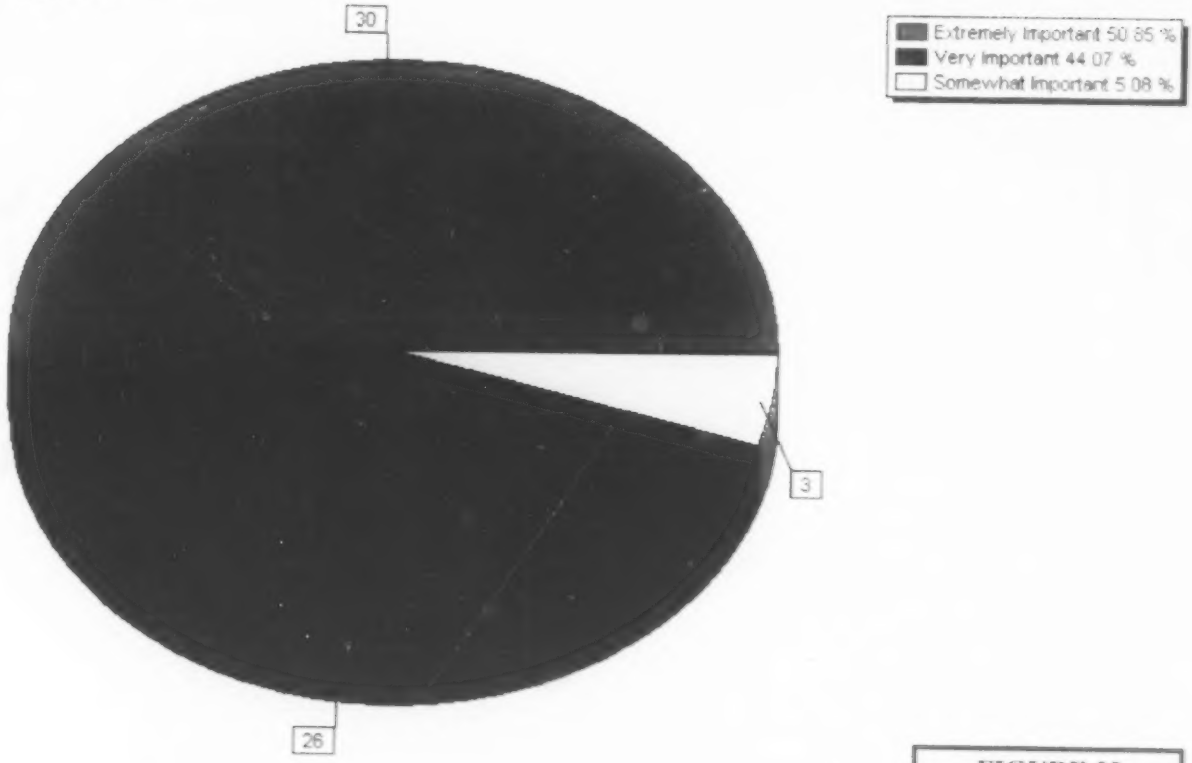

FIGURE 33

Ability to Troubleshoot
Type: Single Choice

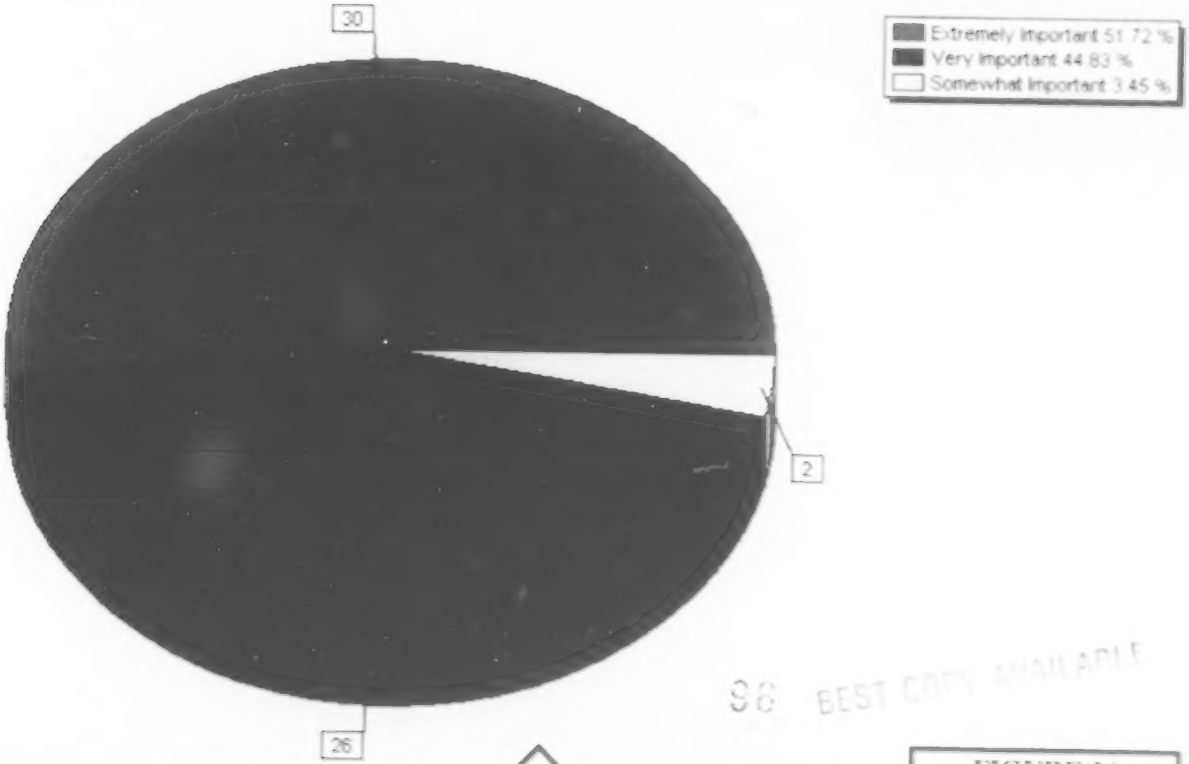

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FIGURE 34

Knowledge of Communication Fundamentals
Type: Single Choice

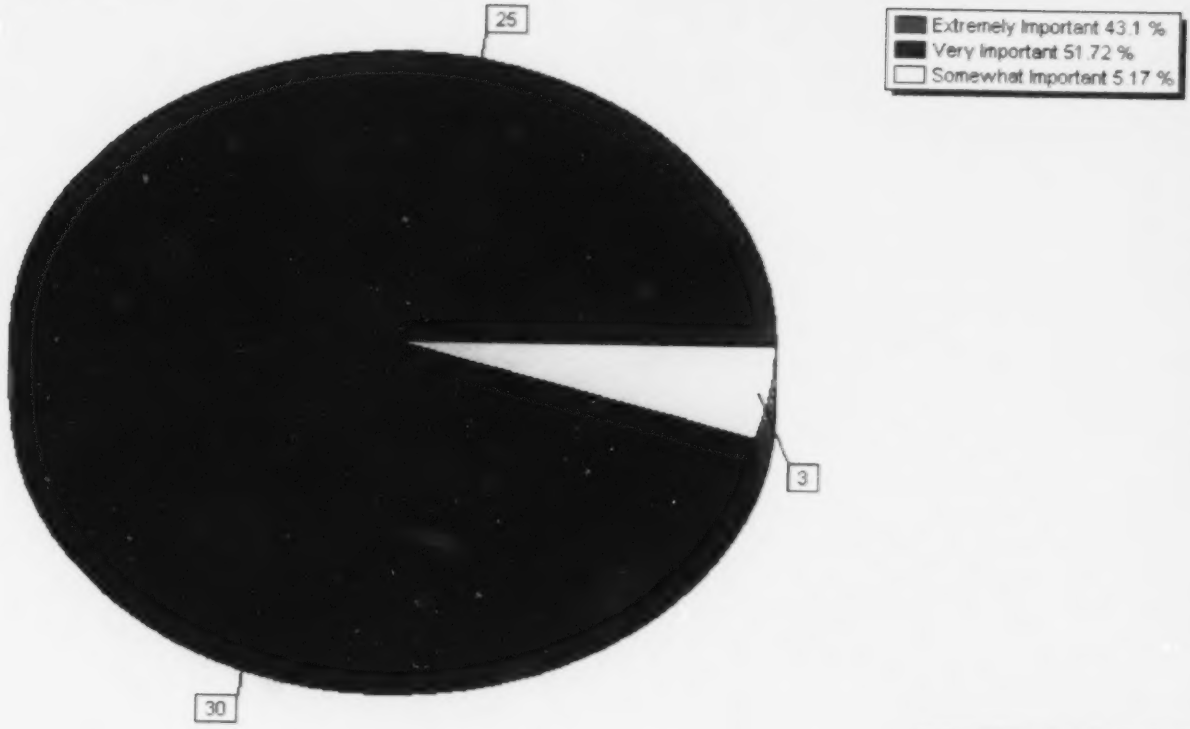

FIGURE 35

Knowledge of Basics of Communications
Type: Single Choice

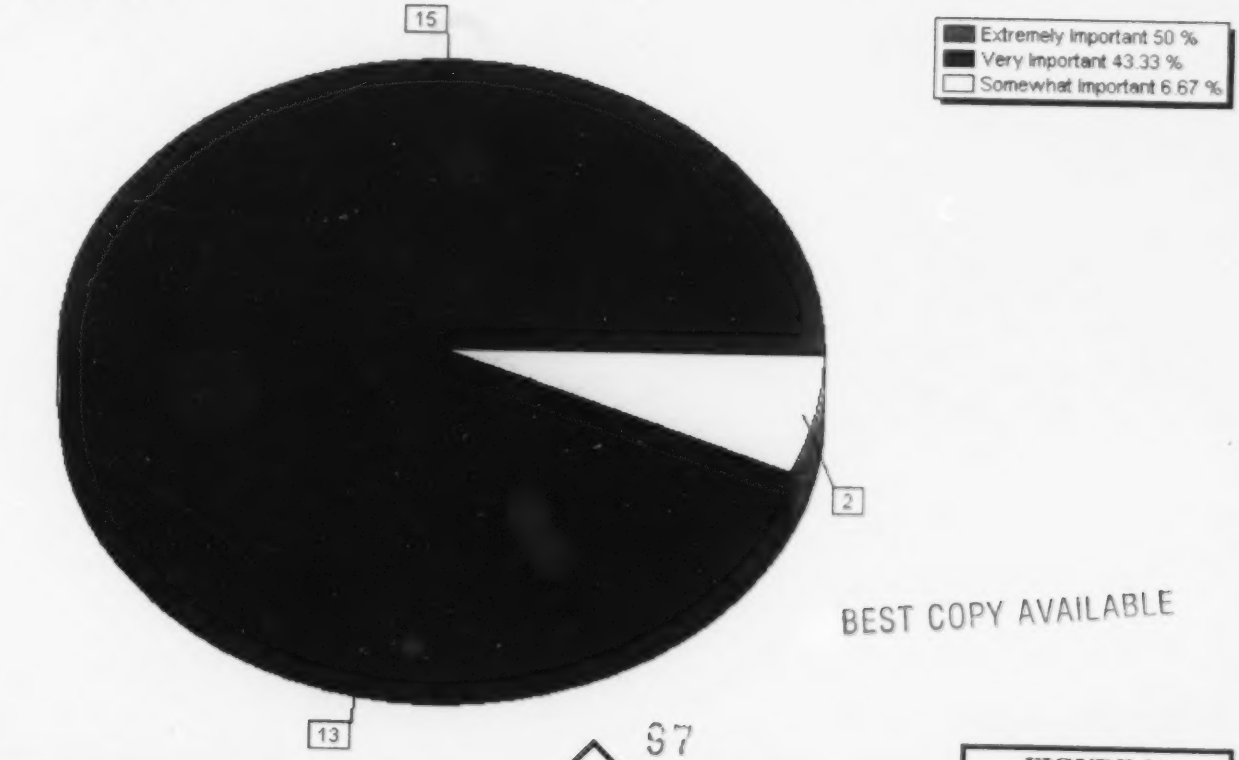

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FIGURE 36

Knowledge of Telecommunications Protocol
Type: Single Choice

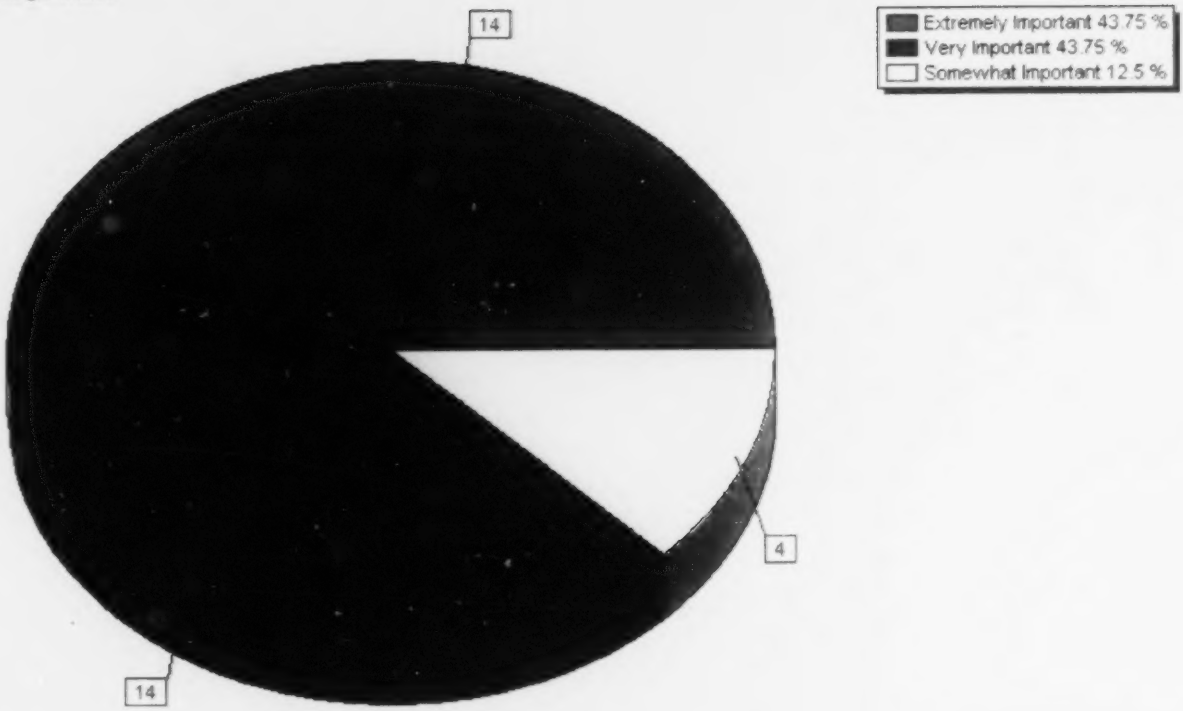

FIGURE 37

Ability to Understand Telcom System Flow
Type: Single Choice

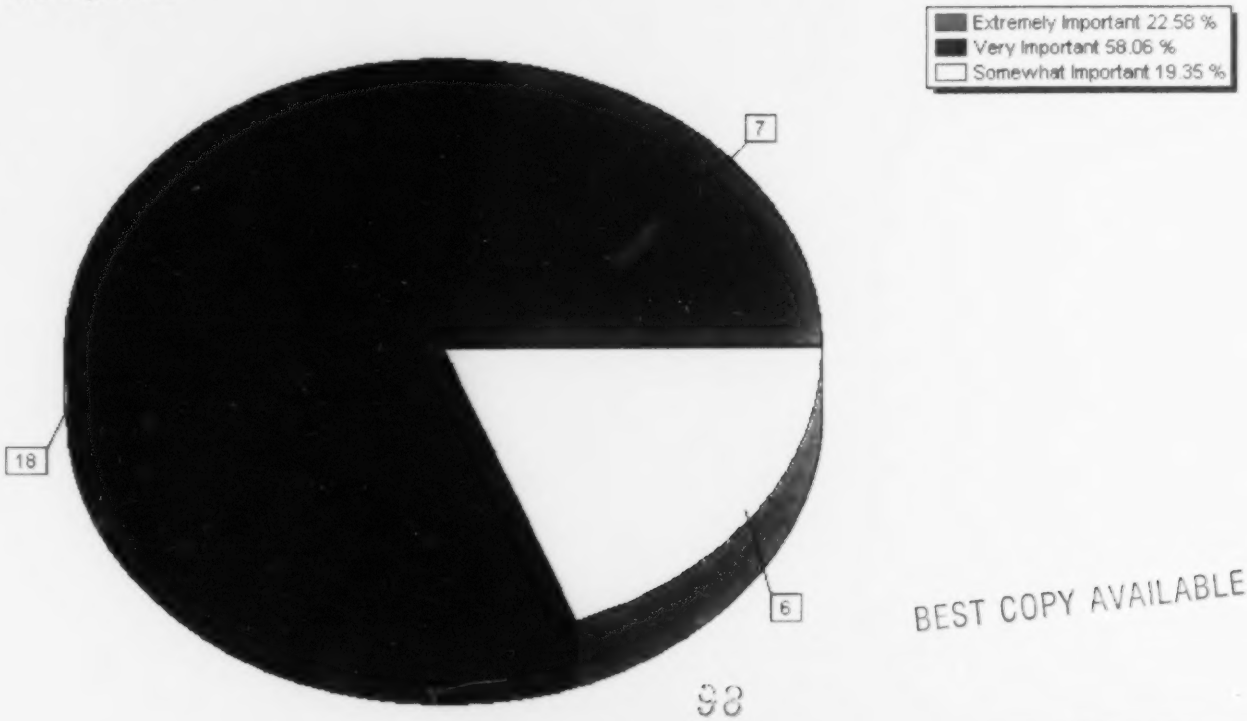

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FIGURE 38

Knowledge of Signal Analysis
Type: Single Choice

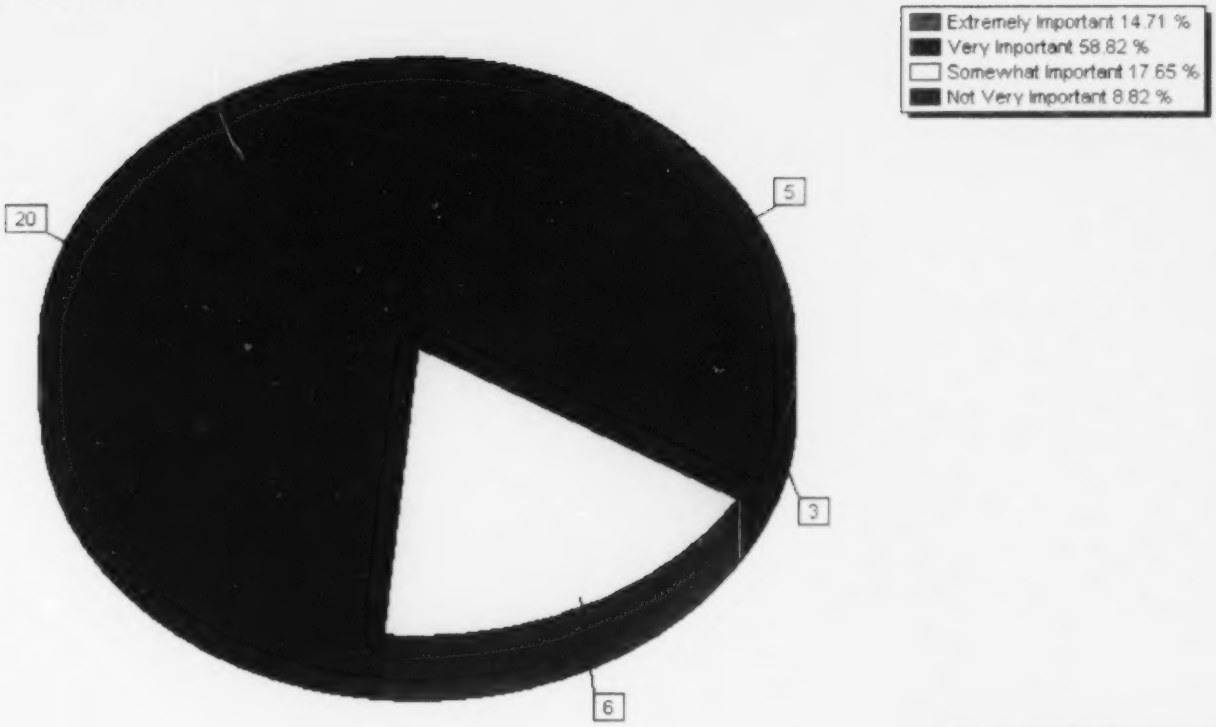

FIGURE 39

Knowledge of HTML
Type: Single Choice

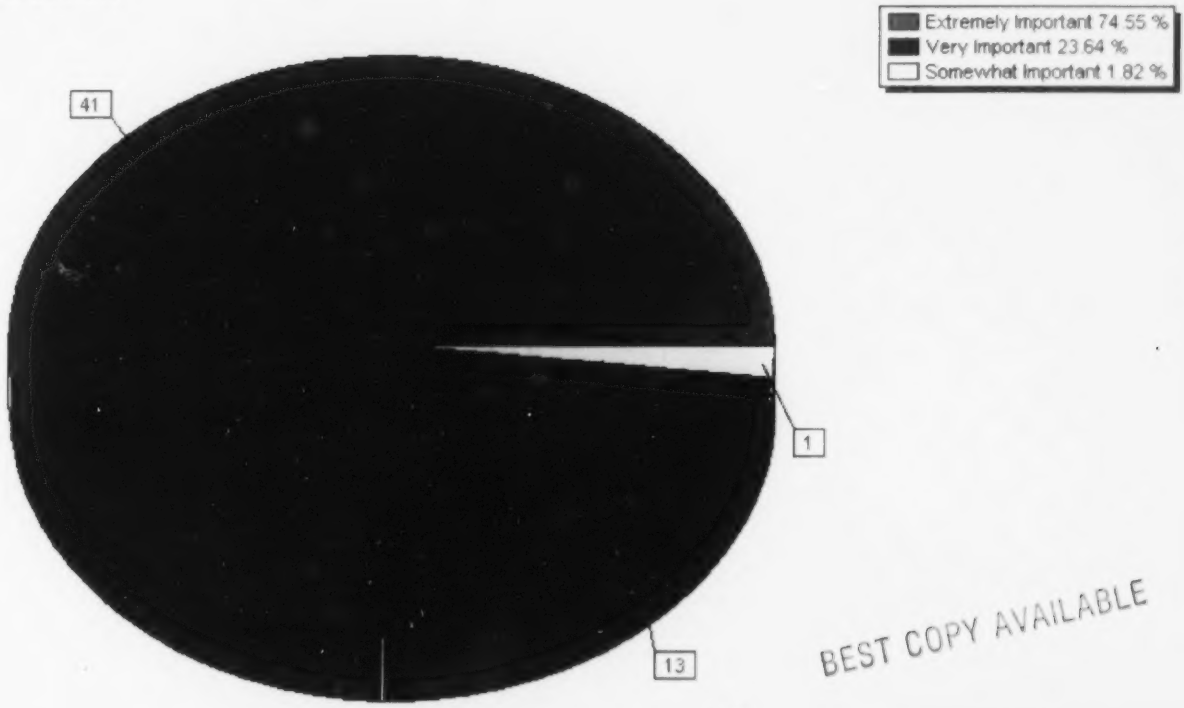

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FIGURE 40

Knowledge of Internet Browsers
Type: Single Choice

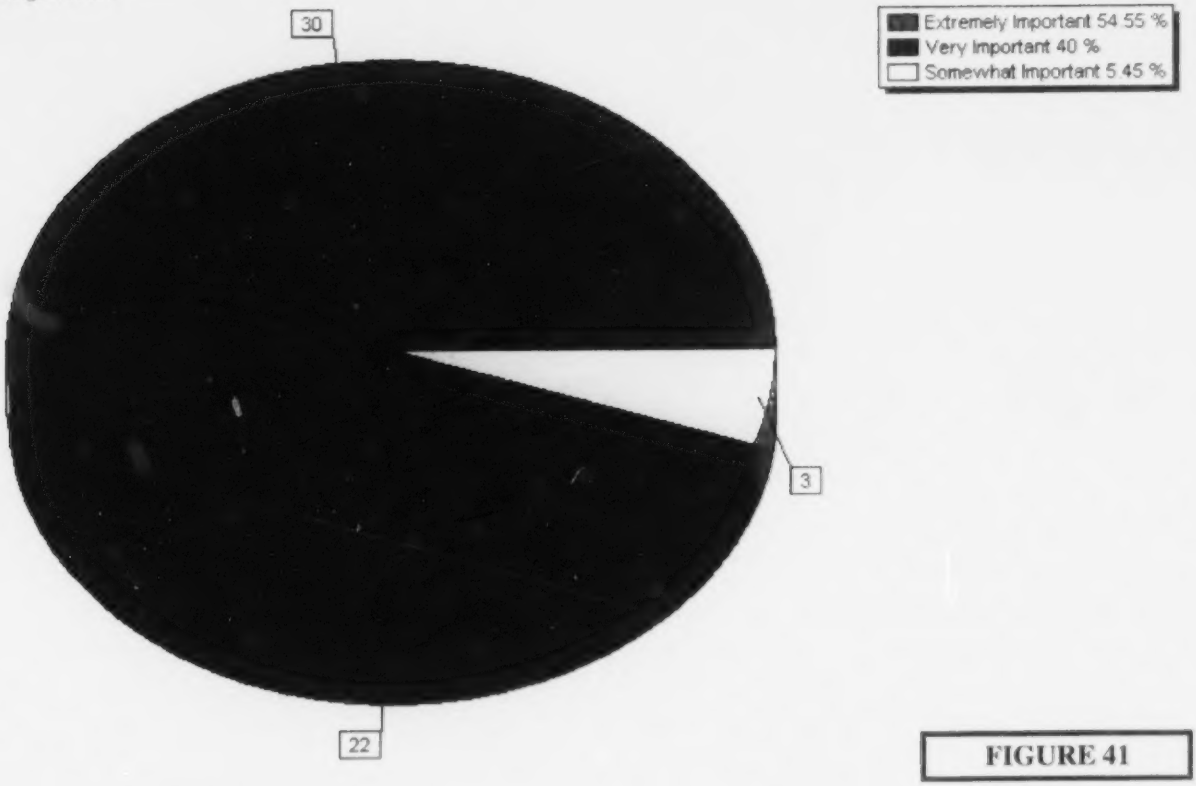

FIGURE 41

Ability to Match Web Solutions to Customer Objectives
Type: Single Choice

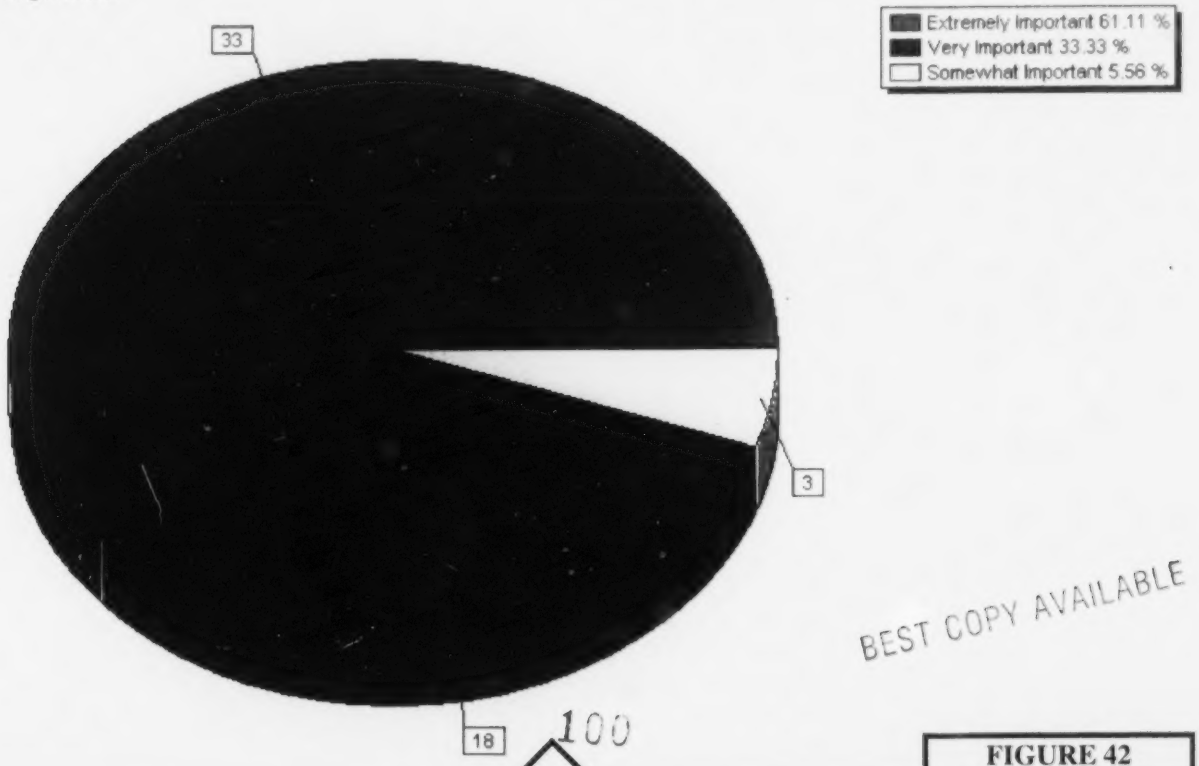

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FIGURE 42

Ability to Meet Customer Needs
Type: Single Choice

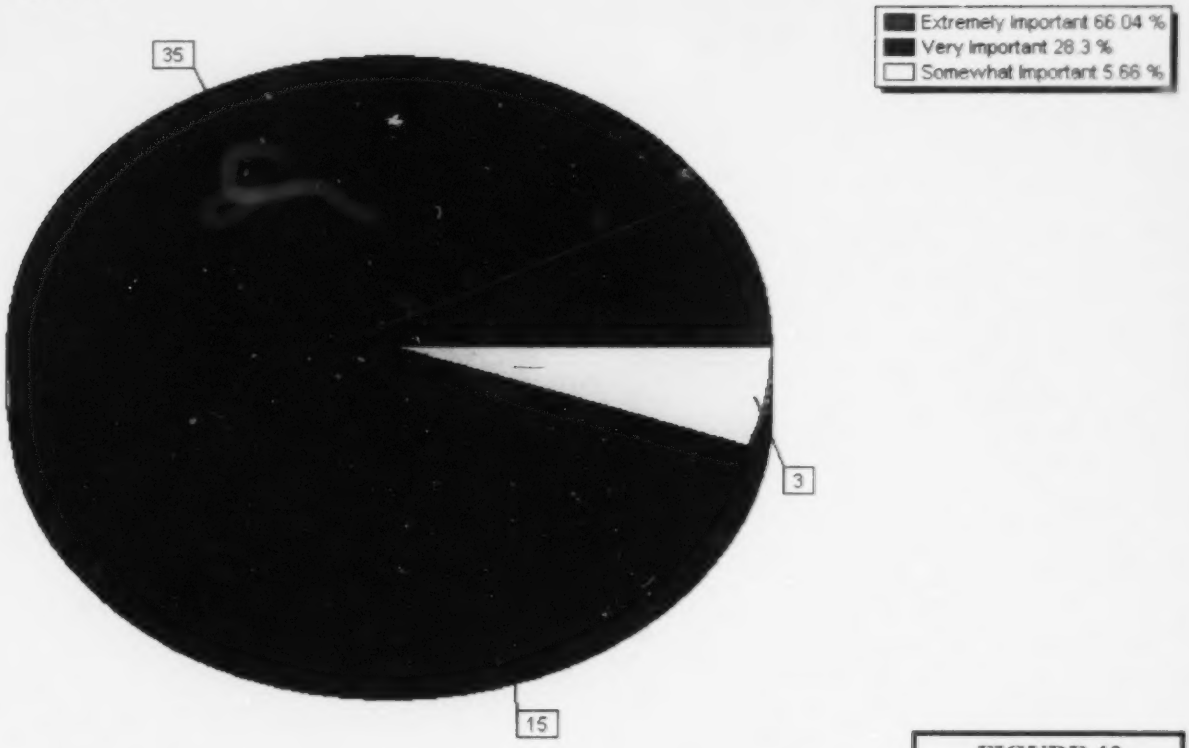

FIGURE 43

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Appendix III – Details of Soft Skills Results

The following tables present the non-technical, soft-skills rankings based on the job cluster within which the respondent classified himself or herself.

SOFT SKILLS (COMPUTER PROGRAMMER)									
Rank	HIGHLY DESIRED CHARACTERSITCS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Problem solving process (decision tree, problem identification, analysis, solving)	92	34	8	4	0	0	63.0	138
2	Listening	54	74	11	0	0	1	64.0	139
3	Team Work (long term)	61	64	14	0	0	1	62.5	139
4	Time management	49	74	14	2	0	1	61.5	139
5	Visualize/conceptualize	48	75	16	0	0	1	61.5	139
6	Adaptability to new technology, new languages	58	64	16	1	0	1	61.0	139
7	Transferring knowledge to application	40	79	16	1	0	1	59.5	136
	DESIRED CHARACTERSITCS								
8	Verbal Communication	32	82	24	0	1	1	57.0	139
9	Constructive criticism (delivery and receipt)	35	70	30	4	0	1	52.5	139
10	Ability to multi-task	50	54	33	2	0	1	52.0	139
11	Business culture (priorities, schedules, self-initiating)	33	69	31	5	0	1	51.0	138
12	Inter-team communication	23	79	34	2	0	1	51.0	138
13	Organizational skills	18	80	38	2	0	1	49.0	138
14	Interpersonal skills	22	72	41	4	0	1	47.0	139
	LESS DESIRED CHARACTERISTICS								
15	Stress management	32	53	43	8	1	1	42.5	137
16	General writing skills	13	62	59	4	0	1	37.5	138
17	Technical writing	11	52	65	9	0	2	31.5	137
18	Leadership (interactions with peers, servant leadership)	14	47	69	7	1	2	30.5	138
19	Diversification (different cultures)	8	27	63	35	4	2	17.5	137
20	Presentation skills	5	24	81	26	1	2	14.5	137

Table 1 - Soft Skills, Computer Programmers

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SOFT SKILLS (SYSTEMS/BUSINESS ANALYSTS)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
			VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Problem solving process (decision tree, problem identification, analysis, solving)	45	28			0	0.0	36.5	74
2	Listening	41	28	3	0	0	0.0	34.5	72
3	Ability to multi-task	39	26	7	2	0	0.0	32.5	74
4	Verbal Communication	37	34	3	0	0	0.0	35.5	74
5	Adaptability to new technology, new languages	37	28	9	0	0	0.5	32.5	74
6	Transferring knowledge to application	33	39	2	0	0	1.0	36.0	74
7	Time management	28	42	4	0	0	1.0	35.0	74
8	Team Work (long term)	35	34	5	0	0	1.0	34.5	74
	DESIRED CHARACTERISTICS								
9	Visualize/conceptualize	23	45	6	0	0	1.0	34.0	74
10	Interpersonal skills	21	45	7	1	0	1.0	33.0	74
11	Business culture (priorities, schedules, self-initiating)	23	43	8	0	0	1.0	33.0	74
12	Organizational skills	16	45	12	0	0	1.0	30.5	73
13	Inter-team communication	17	44	12	0	0	1.0	30.5	73
14	Constructive criticism (delivery and receipt)	20	40	14	0	0	1.0	30.0	74
15	Stress management	15	41	18	0	0	1.0	28.0	74
16	General writing skills	15	38	18	3	0	1.0	26.5	74
17	Leadership (interactions with peers, servant leadership)	10	42	21	1	0	1.0	26	74
	LESS DESIRED CHARACTERISTICS								
18	Technical writing	5	34	30	5	0	1.0	19.5	74
19	Diversification (different cultures)	7	30	29	5	3	1.5	18.5	74
20	Presentation skills	5	26	37	4	0	2.0	15.5	72

Table 2 - Soft Skills, Systems/Business Analysts

SOFT SKILLS (COMPUTER ENGINEER)									
Rank	HIGHLY DESIRED CHARACTERSITCS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Problem solving process (decision tree, problem identification, analysis, solving)	9	2	1	0	0	0.0	5.5	12
2	Team Work (long term)	8	2	1	1	0	0.0	5.0	12
3	Constructive criticism (delivery and receipt)	8	2	1	1	0	0.0	5.0	12
4	Inter-team communication	6	3	2	1	0	0.5	4.5	12
5	Listening	5	7	0	0	0	1.0	6.0	12
6	Time management	5	6	1	0	0	1.0	5.5	12
7	Adaptability to new technology, new languages	5	6	1	0	0	1.0	5.5	12
	DESIRED CHARACTERISTICS								
8	Verbal Communication	4	6	2	0	0	1.0	5.0	12
9	Interpersonal skills	4	6	2	0	0	1.0	5.0	12
10	Business culture (priorities, schedules, self-initiating)	3	7	1	1	0	1.0	5.0	12
11	Transferring knowledge to application	4	6	2	0	0	1.0	5.0	12
12	Ability to multi-task	4	6	2	0	0	1.0	5.0	12
13	Visualize/conceptualize	1	8	3	0	0	1.0	4.5	12
14	Organizational skills	1	8	3	0	0	1.0	4.5	12
15	Stress management	1	7	3	1	0	1.0	4.0	12
16	Technical writing	1	6	2	0	0	1.0	3.5	9
17	Leadership (interactions with peers, servant leadership)	2	5	3	2	0	1.0	3.5	12
	LESS DESIRED CHARACTEISTICS								
18	General writing skills	2	4	6	0	0	1.5	3.0	12
19	Presentation skills	1	4	5	2	0	2.0	2.5	12
20	Diversification (different cultures)	0	1	8	1	2	2.0	0.5	12

Table 3 - Soft Skills, Computer Engineers

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SOFT SKILLS (DATABASE ADMINISTRATORS)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Team Work (long term)	15	13	1	0	0	0	14.0	29
2	Listening	15	12	2	0	0	0	13.5	29
3	Adaptability to new technology, new languages	12	16	1	0	0	1	14.0	29
4	Ability to multi-task	9	18	1	1	0	1	13.5	29
5	Transferring knowledge to application	7	19	3	0	0	1	13.0	29
6	Verbal Communication	9	16	4	0	0	1	12.5	29
7	Visualize/conceptualize	9	15	5	0	0	1	12.0	29
8	Problem solving process (decision tree, problem identification, analysis, solving)	11	13	5	0	0	1	12.0	29
9	Interpersonal skills	7	17	5	0	0	1	12.0	29
	DESIRED CHARACTERISTICS								
10	Time management	13	10	6	0	0	1	11.5	29
11	Inter-team communication	5	17	6	1	0	1	11.0	29
12	Technical writing	3	18	8	0	0	1	10.5	29
13	Constructive criticism (delivery and receipt)	7	14	7	0	0	1	10.5	28
14	Stress management	10	11	8	0	0	1	10.5	29
15	Organizational skills	6	15	8	0	0	1	10.5	29
16	Business culture (priorities, schedules, self-initiating)	7	13	8	0	0	1	10.0	28
17	General writing skills	1	18	9	0	0	1	9.5	28
	LESS DESIRED CHARACTERISTICS								
18	Leadership (interactions with peers, servant leadership)	1	16	12	0	0	1	8.5	29
19	Presentation skills	0	11	16	2	0	2	5.5	29
20	Diversification (different cultures)	1	8	16	4	0	2	4.5	29

Table 4 - Soft Skills, Database Administrators

SOFT SKILLS (COMPUTER SUPPORT SPECIALISTS)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Problem solving process (decision tree, problem identification, analysis, solving)	12	5	0	0	0	0	8.5	17
2	Listening	10	7	0	0	0	0	8.5	17
3	Transferring knowledge to application	9	7	1	0	0	0	8.0	17
4	Ability to multi-task	9	7	1	0	0	0	8.0	17
5	Team Work (long term)	4	13	0	0	0	1	8.5	17
6	Adaptability to new technology, new languages	8	9	0	0	0	1	8.5	17
7	Business culture (priorities, schedules, self-initiating)	4	13	0	0	0	1	8.5	17
8	Stress management	5	11	1	0	0	1	8.0	17
	DESIRED CHARACTERISTICS								
9	Verbal Communication	5	10	2	0	0	1	7.5	17
10	Time management	7	8	2	0	0	1	7.5	17
11	Interpersonal skills	3	12	2	0	0	1	7.5	17
12	Inter-team communication	5	10	2	0	0	1	7.5	17
13	Organizational skills	5	9	3	0	0	1	7.0	17
14	General writing skills	6	7	4	0	0	1	6.5	17
15	Visualize/conceptualize	6	7	4	0	0	1	6.5	17
	LESS DESIRED CHARACTERISTICS								
16	Constructive criticism (delivery and receipt)	5	7	4	1	0	1	6.0	17
17	Diversification (different cultures)	1	10	5	0	1	1	5.5	17
18	Leadership (interactions with peers, servant leadership)	2	9	6	0	0	1	5.5	17
19	Technical writing	1	7	4	0	0	1	4.0	12
20	Presentation skills	1	7	8	1	0	2	4.0	17

Table 5 - Soft Skills, Computer Support Specialists

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SOFT SKILLS (NETWORK SPECIALISTS)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
			VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Adaptability to new technology, new languages	10	7				0	8.5	17
2	Listening	10	7	0	0	0	0	8.5	17
3	Visualize/conceptualize	9	7	1	0	0	0	8.0	17
4	Problem solving process (decision tree, problem identification, analysis, solving)	7	10	0	0	0	1	8.5	17
5	Transferring knowledge to application	7	10	0	0	0	1	8.5	17
6	Team Work (long term)	8	8	1	0	0	1	8.0	17
7	Interpersonal skills	4	12	1	0	0	1	8.0	17
8	Ability to multi-task	6	10	1	0	0	1	8.0	17
9	Inter-team communication	3	13	1	0	0	1	8.0	17
	DESIRED CHARACTERISTICS								
10	Verbal Communication	6	8	2	0	0	1	7.0	16
11	Time management	5	9	3	0	0	1	7.0	17
12	Constructive criticism (delivery and receipt)	3	11	3	0	0	1	7.0	17
13	Business culture (priorities, schedules, self-initiating)	6	8	3	0	0	1	7.0	17
14	Leadership (interactions with peers, servant leadership)	2	11	4	0	0	1	6.5	17
15	Organizational skills	4	9	4	0	0	1	6.5	17
16	General writing skills	2	10	4	1	0	1	6.0	17
17	Stress management	2	9	5	0	1	1	5.5	17
	LESS DESIRED CHARACTERISTICS								
18	Technical writing	1	9	5	2	0	1	5.0	17
19	Presentation skills	1	9	7	0	0	1	5.0	17
20	Diversification (different cultures)	1	2	9	5	0	2	1.5	17

Table 6 - Soft Skills, Network Specialists

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SOFT SKILLS (TELECOMMUNICATIONS ANALYST)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Problem solving process (decision tree, problem identification, analysis, solving)	5	2	0	0	0	0	3.5	7
2	Adaptability to new technology, new languages	5	2	0	0	0	0	3.5	7
3	Verbal Communication	4	3	0	0	0	0	3.5	7
4	Team Work (long term)	4	3	0	0	0	0	3.5	7
5	Ability to multi-task	4	3	0	0	0	0	3.5	7
6	Inter-team communication	4	3	0	0	0	0	3.5	7
	DESIRED CHARACTERISTICS								
7	General writing skills	3	4	0	0	0	1	3.5	7
8	Time management	3	4	0	0	0	1	3.5	7
9	Interpersonal skills	3	4	0	0	0	1	3.5	7
10	Business culture (priorities, schedules, self-initiating)	3	4	0	0	0	1	3.5	7
11	Listening	3	4	0	0	0	1	3.5	7
12	Transferring knowledge to application	2	5	0	0	0	1	3.5	7
13	Stress management	1	6	0	0	0	1	3.5	7
14	Leadership (interactions with peers, servant leadership)	1	6	0	0	0	1	3.5	7
	LESS DESIRED CHARACTERISTICS								
15	Technical writing	3	3	1	0	0	1	3.0	7
16	Visualize/conceptualize	3	3	1	0	0	1	3.0	7
17	Organizational skills	2	4	1	0	0	1	3.0	7
18	Constructive criticism (delivery and receipt)	0	6	1	0	0	1	3.0	7
19	Presentation skills	1	3	3	0	0	1	2.0	7
20	Diversification (different cultures)	0	3	4	0	0	2	1.5	7

Table 7 - Soft Skills, Telecommunication Analysts

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SOFT SKILLS (INTERNET SPECIALISTS)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
			VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Ability to multi-task	8	3	0	0	0	0	5.5	11
2	Team Work (long term)	6	5	0	0	0	0	5.5	11
3	Adaptability to new technology, new languages	8	2	1	0	0	0	5.0	11
4	Organizational skills	7	3	1	0	0	0	5.0	11
5	Problem solving process (decision tree, problem identification, analysis, solving)	6	4	1	0	0	0	5.0	11
6	Visualize/conceptualize	8	1	2	0	0	0	4.5	11
7	Time management	6	3	2	0	0	0	4.5	11
	DESIRED CHARACTERISTICS								
8	Verbal Communication	5	5	1	0	0	1	5.0	11
9	Listening	5	5	1	0	0	1	5.0	11
10	Business culture (priorities, schedules, self-initiating)	4	6	1	0	0	1	5.0	11
11	Transferring knowledge to application	4	6	1	0	0	1	5.0	11
12	Inter-team communication	3	7	1	0	0	1	5.0	11
13	Constructive criticism (delivery and receipt)	3	6	2	0	0	1	4.5	11
14	Interpersonal skills	3	5	3	0	0	1	4.0	11
15	Stress management	2	6	2	1	0	1	4.0	11
16	General writing skills	4	3	4	0	0	1	3.5	11
	LESS DESIRED CHARACTERISTICS								
17	Leadership (interactions with peers, servant leadership)	1	4	5	1	0	2	2.5	11
18	Diversification (different cultures)	1	3	4	2	1	2	2.0	11
19	Technical writing	0	4	6	1	0	2	2.0	11
20	Presentation skills	1	2	7	1	0	2	1.5	11

Table 8 - Soft Skills, Internet Specialists

Appendix IV – Details of Business Concepts Results

The following tables present the business concepts rankings based on the job cluster within which the respondent classified himself or herself.

BUSINESS CONCEPTS (COMPUTER PROGRAMMER)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Investigative skills (probing questions)	32	71	35	7	0	1	51.5	145
2	"Be the customer" mentality	31	64	47	3	1	1	47.5	146
3	Idea initiation	17	58	62	5	2	1	37.5	144
4	Project Management	19	42	62	20	3	1	30.5	146
	DESIRED CHARACTERISTICS								
5	Interviewing skills	12	24	54	36	18	2	18.0	144
6	Mediation skills	2	17	84	39	4	2	9.5	146
	LESS DESIRED CHARACTERSITCS								
7	Use of capital (risk and return)	0	10	37	72	26	3	5.0	145
8	Role playing	2	8	55	63	18	3	5.0	146
9	Marketing	2	8	43	64	26	3	5.0	143
10	Basic accounting	3	5	44	61	31	3	4.0	144
11	Reading a budget (and understanding)	0	6	30	80	27	3	3.0	143
12	Reading a balance sheet and income and expense summary	0	4	27	75	39	3	2.0	145

Table 9 - Business Concepts, Computer Programmers

BUSINESS CONCEPTS (SYSTEMS/BUSINESS ANALYST)									
Rank	HIGHLY DESIRED CHARACTERSITCS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Investigative skills (probing questions)	30	36	6	1	0	1	33.0	73
2	"Be the customer" mentality	29	35	8	0	0	1	32.0	72
3	Idea initiation	16	36	20	1	0	1	26.0	73
4	Project Management	16	35	20	2	0	1	25.5	73
	DESIRED CHARACTERSITCS								
5	Mediation skills	4	22	34	12	1	2	13.0	73
6	Interviewing skills	5	19	29	17	3	2	12.0	73
	LESS DESIRED CHARACTERISTICS								
7	Marketing	1	12	34	23	3	2	6.5	73
8	Reading a budget (and understanding)	0	12	33	22	1	2	6.0	68
9	Role playing	0	11	28	28	6	2	5.5	73
10	Basic accounting	2	8	35	18	10	2	5.0	73
11	Use of capital (risk and return)	0	9	41	22	1	2	4.5	73
12	Reading a balance sheet and income and expense summary	0	4	31	29	9	3	2.0	73

Table 10 - Business Concepts, Systems/Business Analysts

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BUSINESS CONCEPTS (COMPUTER ENGINEER)									
Rank	HIGHLY DESIRABLE CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	"Be the customer" mentality	4	7	0	1	0	1.0	5.5	12
2	Investigative skills (probing questions)	4	7	0	1	0	1.0	5.5	12
3	Idea initiation	4	6	1	0	0	1.0	5.0	11
4	Project Management	2	6	4	0	0	1.0	4.0	12
5	Interviewing skills	2	4	5	1	0	1.5	3.0	12
	DESIRABLE CHARACTERISTICS								
6	Mediation skills	1	2	5	4	0	2.0	1.5	12
7	Use of capital (risk and return)	0	2	6	4	0	2.0	1.0	12
8	Reading a budget (and understanding)	0	2	5	5	0	2.0	1.0	12
9	Role playing	1	1	7	1	2	2.0	1.0	12
	LESS DESIRABLE CHARACTERISTICS								
10	Reading a balance sheet and income and expense summary	0	1	3	7	1	3.0	0.5	12
11	Basic accounting	0	1	2	8	1	3.0	0.5	12
12	Marketing	1	0	4	6	1	3.0	0.5	12

Table 11 - Business Concepts, Computer Engineers.

BUSINESS CONCEPTS (DATABASE ADMINISTRATOR)									
Rank	HIGHLY DESIRABLE CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	"Be the customer" mentality	7	19	1	2	0	1	13.0	29
2	Idea initiation	4	20	4	1	0	1	12.0	29
3	Investigative skills (probing questions)	7	13	8	1	0	1	10.0	29
4	Project Management	3	17	9	0	0	1	10.0	29
	DESIRABLE CHARACTERISTICS								
5	Interviewing skills	3	8	12	5	1	2	5.5	29
6	Role playing	1	6	11	9	2	2	3.5	29
7	Use of capital (risk and return)	0	6	12	10	1	2	3.0	29
8	Mediation skills	0	6	16	7	0	2	3.0	29
	LESS DESIRABLE CHARACTERISTICS								
9	Reading a budget (and understanding)	2	3	13	11	0	2	2.5	29
10	Marketing	1	4	15	6	3	2	2.5	29
11	Basic accounting	1	2	12	11	3	2	1.5	29
12	Reading a balance sheet and income and expense summary	1	1	10	15	2	3	1.0	29

Table 12 - Business Concepts, Database Administrators

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BUSINESS CONCEPTS (COMPUTER SUPPORT SPECIALIST)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	"Be the customer" mentality	8	8	1	0	0	1	8.0	17
2	Investigative skills (probing questions)	6	9	2	0	0	1	7.5	17
3	Idea initiation	4	10	3	0	0	1	7.0	17
4	Project Management	4	8	4	1	0	1	6.0	17
	DESIRED CHARACTERISTICS								
5	Interviewing skills	2	5	6	3	1	2	3.5	17
6	Mediation skills	2	5	8	1	1	2	3.5	17
7	Basic accounting	1	5	7	4	0	2	3.0	17
	LESS DESIRED CHARACTERISTICS								
8	Role playing	0	5	7	4	1	2	2.5	17
9	Use of capital (risk and return)	0	4	10	3	0	2	2.0	17
10	Reading a budget (and understanding)	1	3	9	4	0	2	2.0	17
11	Reading a balance sheet and income and expense summary	1	3	6	6	1	2	2.0	17
12	Marketing	2	2	9	4	0	2	2.0	17

Table 13 - Business Concepts, Computer Support Specialists

BUSINESS CONCEPTS (NETWORK SPECIALISTS)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Investigative skills (probing questions)	9	7	1	0	0	0	8.0	17
2	"Be the customer" mentality	6	9	2	0	0	1	7.5	17
3	Idea initiation	1	13	3	0	0	1	7.0	17
4	Project Management	2	10	5	0	0	1	6.0	17
	DESIRED CHARACTERISTICS								
	Interviewing skills	4	4	5	4	0	2	4.0	17
5	Mediation skills	0	6	9	2	0	2	3.0	17
6	Use of capital (risk and return)	0	3	8	4	2	2	1.5	17
7	Reading a budget (and understanding)	0	3	8	5	1	2	1.5	17
8	Role playing	2	1	8	4	2	2	1.5	17
9	LESS DESIRED CHARACTERISTICS								
10	Basic accounting	1	1	9	5	1	2	1.0	17
11	Marketing	1	1	12	3	0	2	1.0	17
12	Reading a balance sheet and income and expense summary	0	0	10	3	4	2	0.0	17

Table 14 - Business Concepts, Network Specialists

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BUSINESS CONCEPTS (TELECOMMUNICATIONS ANALYST)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	"Be the customer" mentality	2	5	0	0	0	1	3.5	7
2	Project Management	3	2	2	0	0	1	2.5	7
3	Idea initiation	2	3	2	0	0	1	2.5	7
4	Investigative skills (probing questions)	2	3	2	0	0	1	2.5	7
5	Mediation skills	0	4	3	0	0	1	2.0	7
	DESIRED CHARACTERISTICS								
6	Use of capital (risk and return)	0	3	4	0	0	2	1.5	7
7	Reading a budget (and understanding)	0	2	5	0	0	2	1.0	7
8	Interviewing skills	0	2	5	0	0	2	1.0	7
9	Marketing	0	2	4	1	0	2	1.0	7
	LESS DESIRED CHARACTERISTICS								
10	Reading a balance sheet and income and expense summary	0	1	3	3	0	2	0.5	7
11	Basic accounting	0	1	6	0	0	2	0.5	7
12	Role playing	0	0	5	1	1	2	0.0	7

Table 15 - Business Concepts, Telecommunication Analysts

BUSINESS CONCEPTS (INTERNET SPEICALIST)									
Rank	HIGHLY DESIRED CHARACTERISTICS	0	1	2	3	4			
		EI	VI	SI	NVI	NI	MED	(EI+VI)/2	N
1	Project Management	3	6	2	0	0	1	4.5	11
2	"Be the customer" mentality	4	4	3	0	0	1	4.0	11
3	Idea initiation	4	4	3	0	0	1	4.0	11
	DESIRED CHARACTERISTICS								
4	Investigative skills (probing questions)	3	2	6	0	0	2	2.5	11
5	Use of capital (risk and return)	2	2	2	3	2	2	2.0	11
6	Marketing	1	3	4	3	0	2	2.0	11
7	Mediation skills	0	3	4	4	0	2	1.5	11
8	Reading a budget (and understanding)	1	1	4	5	0	2	1.0	11
9	Role playing	0	1	5	4	1	2	0.5	11
	LESS DESIRED CHARACTERISTICS								
10	Basic accounting	1	1	2	6	1	3	1.0	11
11	Interviewing skills	0	2	3	5	1	3	1.0	11
12	Reading a balance sheet and income and expense summary	0	2	1	7	1	3	1.0	11

Table 16 - Business Concepts, Internet Specialist

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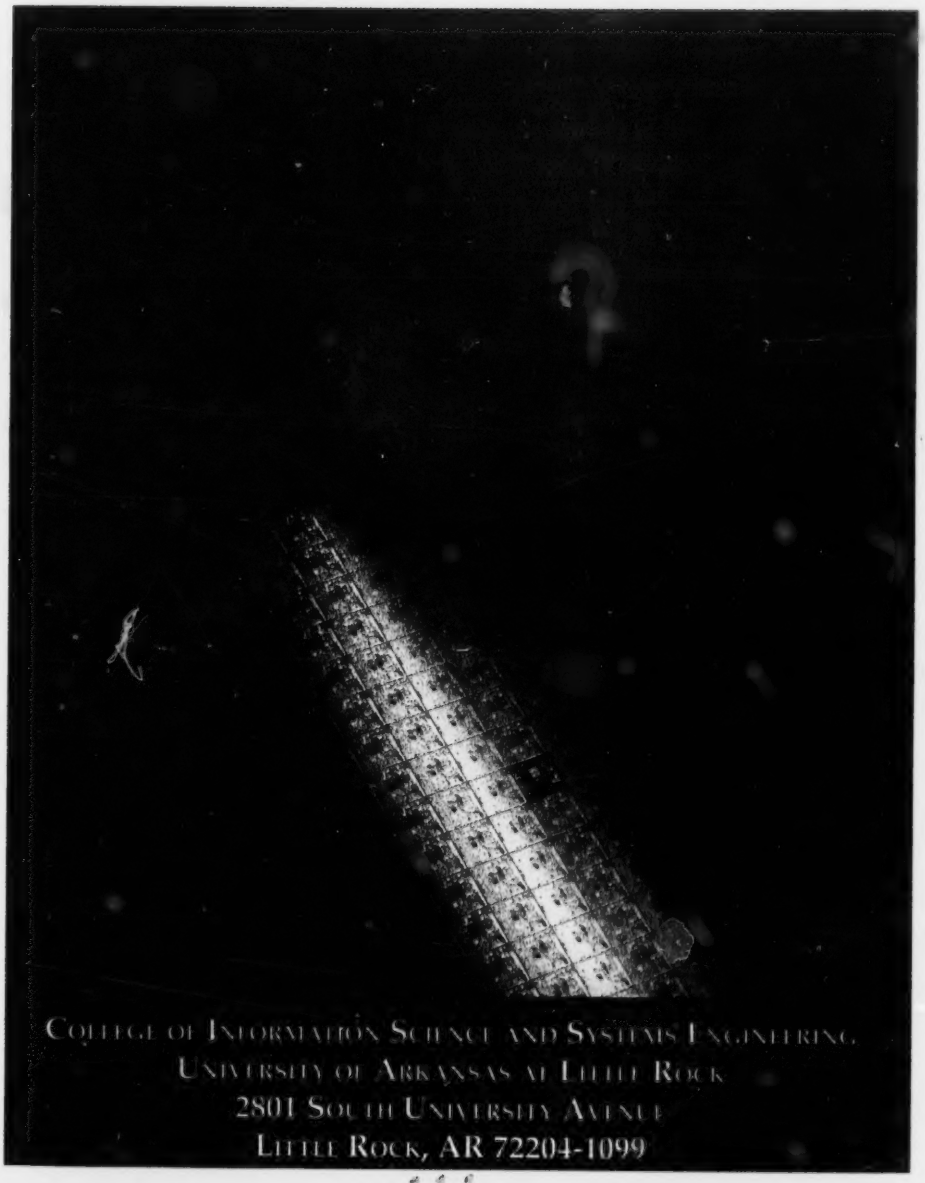
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